JUL 5 1934

Factory

MANAGEMENT and MAINTENANCE

July • 1934

Factory Management and Maintenance serves the men in manufacturing industries who are responsible for management, those who are responsible for maintenance, those who are responsible for the interlocking functions of management and maintenance.

Well-ordered planning is ineffective without buildings and equipment that are properly maintained for instant and continuous service. And the perfectly maintained plant is helpless without thoroughly developed operating plans.

The men carrying the responsibilities for plant operation must know the problems incident to both functions. They must coordinate management and maintenance activities in the interest of profitable operation.

Factory Management and Maintenance provides the information to make possible good management, complete maintenance, and effective coordination. It aims to be a complete service to every plant-operation man.

No man in an important plant-operation job can afford to be without *Factory Management and Maintenance. Every* plant-operation job *is* important.

McGRAW-HILL PUBLISHING COMPANY, INC.

MOHAWK CARPET MILLS
The Shuttleworth Division and the McCleary Division (below) at Amsterdam, N. Y. Owners: Mohawk Carpet Mills, Incorporated. 445,300 square feet of Barrett Specification Roofs applied by Kaiser-Boswell Company, Inc., Amsterdam.

EXPENSE-FREE, TROUBLE-FREE ROOFS

CUT DOWN OPERATING COSTS...

Photos: Fairchild Aerial Surveys, Inc.

Once a company discovers the merits of Barrett materials and methods, the advantages of doing business with Barrett Approved Roofers and the completeness of Barrett Inspection Service, it loses interest in experimenting with ordinary roofs.

Barrett Specification Roofs are bonded against repair and maintenance expense for periods up to 20 years, but the term of the bond only begins to measure the life of the roof. Day after day, year after year, they provide the sort of expense-free, worry-free, *fire-safe* protection plant engineers appreciate. No need to think about possible shut-downs or upset production schedules because of leaky roofs . . .

Eighty years of successful manufacturing experience plus unmatched performance records have established Barrett Roofs as the most dependable roof protection America has developed. Sound business judgment dictates that these roofs will cost less in the long run.

Consult with us or your local Barrett Approved Roofer on any roofing or waterproofing problem.

THE BARRETT COMPANY

40 Rector Street **New York, N. Y.**
2800 So. Sacramento Ave., Chicago, Ill.
Birmingham, Alabama

RECOVER RIGHT WITH BARRETT ROOFS

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Factory Management *and* Maintenance

A consolidation of *Factory and Industrial Management* and *Maintenance Engineering*

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Systematic inspection keeps the little defects from growing up to be major breakdowns

Now's the Time to Put Buildings in Shape ..... G. W. BORDEN 325
Also to stop leaving undone those things that ought to have been done long, long ago

To Estimate Wiring Costs ..... MONTROSE EDMONDS 327
Someone in your plant will have to do it some day. So here's his help in time of need

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NRA U.S. CODE GRAPHIC ARTS INDUSTRY 1934 REGISTRATION NO. 3H568

It was in all the daily papers

(*the Sinclair Oil collective bargaining agreement, we mean*)

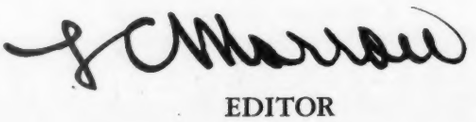
•

Yes, it was, but not the whole story. Daily papers are for popular consumption; they can't serve industry's requirements for complete, specific information.

The popular part of the story was that Sinclair had signed an agreement with the A. F. of L. The part of the story not told was how the Sinclair companies would deal with non-union employees and employee-representation groups.

That part of the story is wanted by industry; that part of the story FACTORY gives in this issue—also Mr. Sinclair's viewpoint—also the agreement in full.

This quick, full service concerning an outstanding labor development is evidence that no man in an important plant-operation job can afford to be without FACTORY MANAGEMENT and MAINTENANCE. *Every* plant-operation job *is* important.



EDITOR

FACTORY MANAGEMENT and MAINTENANCE

JULY, 1934

No Strikes, No Lockouts

Say Sinclair Oil and A. F. of L. in collective bargaining agreement

OUTSTANDING recent development in the history of labor relations is the Sinclair-A. F. of L. agreement, reached last month. It has been vilified and praised; for the moment let the ayes and noes cancel each other, and consider the agreement itself. At the end of the year during which it is to be in effect the results achieved under it may positively indicate either the feasibility or futility of such an arrangement.

This agreement is a contract between an employer (Consolidated Oil Corporation) and that portion of employees choosing an A. F. of L. union (International Association of Oil Field, Gas Well and Refinery Workers) as its bargaining representative. Non-union employees are, or may be, represented in other ways. The attitude of Mr. Sinclair toward labor relations is set forth in the accompanying statement written at the request of *Factory Management and Maintenance*.

According to information obtained from an executive of the corporation:

1. The proportion of employees who are members of unions varies greatly in different parts of the country and in different operations. In some of the refineries the percentage of employees belonging to the International Association is as high as 85. In other places it is practically negligible. On the average, taking all operations, it is estimated that half of the employees belong. (Total employment in the companies affected is approximately 15,000.)

2. Sinclair companies will deal with the remaining employees on any basis that they choose to set up. When any group or section of employees designates an agency for collective bargaining that agency will be dealt with.

3. In a number of the plants employee associations exist. Some are old, some are new. Where employees prefer this kind of agency for collective bargaining the corporation will deal with it as it has in the past. The constitutions and by-laws of these associations amount practically to agreements so far as collective bargaining is concerned.

4. Non-union employees will have the same privileges and restrictions under which the union employees work.

H. F. Sinclair Statement

Prepared for *Factory Management and Maintenance*

Everyone seems to agree that the labor problem is one of the most important with which industry has to deal. It is also generally agreed that the solution of this problem will have a most important bearing upon the success of the whole recovery program.

We have made an agreement with a union representing a large number of our employees in production, pipe line, transportation, and refining operations because it was an undeniable fact that this union included in its membership a large number of our employees. The Recovery Act requires us to deal with any properly designated representative of employees. The union is such a representative. It may not be the only one, but it is an important one. The Recovery Act does not require anybody to make any kind of written agreement, but it is generally

considered desirable when any sort of contract or agreement is made that it be reduced to writing so that its terms may be exactly known to both parties. This rule seems to us to apply to labor agreements as well as to all others.

The contract is not a closed shop arrangement. It simply provides a basis for doing business with a large section of the men who work for us. In my opinion it is a good, sound arrangement. It is a firm engagement on the one side that there will be no strikes and an equally firm engagement by both parties that a clearly defined procedure shall be followed for the settlement of wage and other controversies, localized or general.

I cannot imagine that injustice under this procedure could be done either to the employees or to the employer. There certainly is no greater risk in this regard than there is in going into the courts for the settlement of disputes. The outstanding difference, of course, is that the employer and the employee keep the settlement of their differences, if there are any, within their own family, for the sound reason, as Mr. Green says, that "after all, the people most concerned should handle their own affairs and make their own rules of procedure."

I have nothing to say to those whose policy is guided by an ingrained prejudice against labor unions. Labor organizations are a fact and I can recognize them just as easily as I can the Empire State Building.

ARTICLES OF AGREEMENT

Between Sinclair Refining Company, Sinclair Prairie Oil Company, Sinclair Prairie Oil Marketing Company, Sinclair Prairie Pipe Line Company, Rio Grande Oil Companies, each hereinafter referred to as "Employer," and International Association of Oil Field, Gas Well and Refinery Workers of America, Acting on Behalf of Such of the Employees of the Employer or Employers Who Are Members of the International Association.

Whereas the parties to this agreement intend to promote an increasing spirit of harmony between Employer and such of the Employees of the Employer who are members of the above named Association and to insure the most efficient operation of the facilities of the Employer.

Now, therefore, it is understood and agreed as follows:

ARTICLE I

This agreement shall apply to the refining operations only as conducted by Sinclair Refining Company; the development and/or production of crude oil and/or natural gasoline by Sinclair Prairie Oil Company; the purchase and marketing of crude oil by Sinclair Prairie Oil Marketing Company, and the transportation of crude oil by Sinclair Prairie Pipe Line Company; and the aforementioned activities of the Rio Grande Oil Companies.

ARTICLE II

This agreement shall continue for a period of one year beginning June 1, 1934, and thereafter unless terminated by either party on thirty days' written notice by the party electing to terminate. Within said period of thirty days the parties hereto shall confer for the purpose of mutually considering upon what terms and conditions this agreement may be extended instead of terminated.

ARTICLE III

It is agreed there shall be no cessation of work through strikes or lockouts during the term of this agreement.

ARTICLE IV

All grievances and disputes as to wages and working conditions arising between the Employer and the Employees herein mentioned shall be governed by the terms of this agreement. Whenever any such grievance or dispute arises which cannot be otherwise adjusted the parties hereto agree that the same shall be decided in the manner provided for in Article XXIII hereof.

ARTICLE V

Employees in any classification are expected to perform any duties to which they may be assigned. If work of a higher paid classification is temporarily required of any Employee, he shall receive the wage of the position to which he has been assigned and for as long a time as he occupies that position. If an Employee is temporarily shifted to any position paying a smaller wage than he has been receiving, no reduction in wages shall be made, but in cases where a man's services are no longer required in his class, the Employer may, with the Employee's consent, instead of laying such Employee off, transfer him to any other position vacant and fix the wage according to that position.

ARTICLE VI

In filling vacancies in the higher classifications the Employer accepts the principle of exercising due regard for length of service, taking into account ability and efficiency; and the general practice will be followed of promoting those who, by length of service and ability, shall be deemed to have earned promotion. Nothing in this Article, however, shall interfere with the right of the Employer to promote any individual for unusually meritorious service or exceptional ability. Any Employee laid off through reduction of forces or for any other reason beyond his control and re-employed within sixty (60) days shall be considered a regular employee as regards his service rating.

ARTICLE VII

In the event of emergencies when an Employee is called for duty outside of his regular working hours he shall receive pay for actual time worked at one and one-half times his regular rate with a minimum of three hours' pay. In the event no work shall be required of an Employee called out for such emergency, he shall receive pay for two hours at his regular rate.

ARTICLE VIII

All work peculiar to any classified employment (job) shall be done by men regularly assigned to that classification (job) except in cases of extreme emergency.

ARTICLE IX

Employees shall not be required as a condition of employment to submit to a physical examination by a physician in the pay of the Employer or its agents, but may furnish a certificate of current date from any reputable doctor of the Employee's own choosing. In the case of Employees being absent from work due to illness or physical impairment they shall be readmitted to work upon the presentation of a certificate of physical fitness, signed by any accredited physician. This rule, however, shall not limit the right of the Employer to require physical examination by a physician in the Employer's service in exceptional cases or in cases of constantly recurring absence from duty.

ARTICLE X

Hours of labor shall not exceed those specified in the Petroleum Code. Pro-

(Continued on advertising page 48)

rail bucket, presses the "forward" button on the pushbutton control, which moves the bucket to, and stops it at, a scale located adjacent to the control board shown in the center. After noting the weight, he turns a switch on the board which lights a telltale and automatically dispatches the bucket of disks to the machine that needs them.

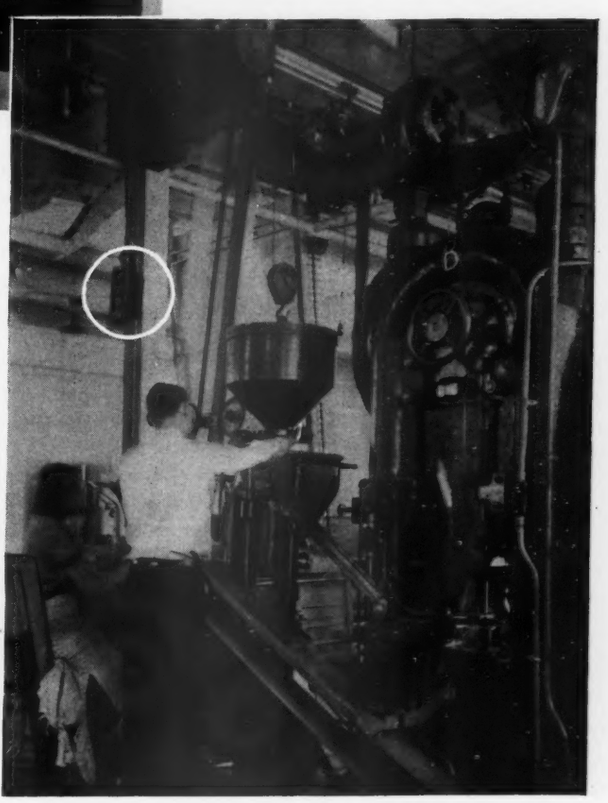
At this point, one of the mechanics on the floor steps up, lowers the bucket, opens a slide in the bottom, and dumps the disks into the machine hopper.

He then raises the bucket, punches the "reverse" button, and sends the bucket back to the stockroom.

Circled in the lower photograph is the pushbutton control, which rides along with the bucket. It has five buttons—"raise" and "lower" on one side; "forward," "stop," and "reverse" on the other.

Aside from the saving in time and labor, there is none of the confusion which is so frequently a direct accompaniment of manual handling.

One man does the handling at the Sun Tube Corporation, where blanks for collapsible tubes are automatically monorailed from storage bins to the machines



All by himself

ONE MAN, an electric monorail with pushbutton control, and an automatic dispatching system see to it that machines never have to wait for materials in the Sun Tube Corporation's plant at Hillside, New Jersey.

This concern makes collapsible tubes for toothpastes, cosmetics, and similar products. The tubes are extruded from pure tin disks, which are first stamped out, falling into square cans on casters, are then dumped by means of a pneumatic hoist into a tumbling barrel and moved via monorail to stock bins. The tumbling operation removes burs and serves also to lubricate the disks so that they may be more readily extruded.

When a machine operator sees her supply of disks is running low, she presses a button which causes the number of her machine to show on the annunciator circled in the upper photograph. The stock boy fills his mono-

Rodney Wilcox Jones
President
Augusta Knitting Corporation
Utica, N. Y.

If This Mill Looks Empty

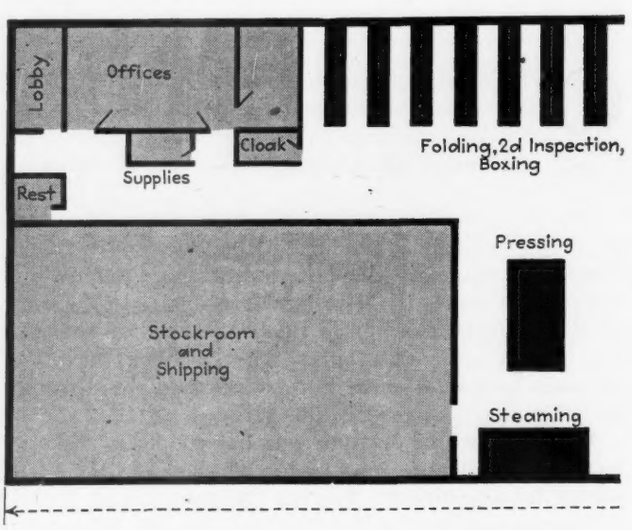
. . . it's because it is laid out on a single floor and goods "march" through faster than we ever dreamed they would

WE HAD a single thought in mind when we laid out our present mill and began manufacturing operations early this year. It was to convert yarn into finished suits of underwear, sweaters, and bathing suits with the fewest possible lost motions.

Hence our present layout which, as you will see from the accompanying diagram, places all manufacturing processes on one floor. To this efficient plan, which provides for continuous and rapid flow of work in process, we attribute the undeniable fact that we are doing a quicker manufacturing job and a better one.

Contrast this plan with our old mill, which occupied four floors and approximately three times the present floor area. Beginning at the top came cutting, then winding and knitting, finishing, folding and pressing in that order. Picture the necessary handling between operations and floors, the unavoidable delays while waiting for truckers or elevators. Is it hard to believe that we can now deliver the average order in something like two-thirds of the time formerly needed?

This is an important advantage these days, whatever the industry or the product, and one which has enabled us to keep in step with modern buying practices. It has meant, too, a smaller inventory of work in process and a smaller stock of finished goods. Indeed, the only quarrel we could possibly pick with our present manufacturing layout is that goods "march" through far more quickly than we ever dreamed they could, and with an



ease which leaves us with the uncomfortable feeling that the plant is somehow emptier than it ought to be.

Take a specific case. We get an order for, say, a hundred dozen bathing suits. They are knit today, steamed tomorrow, then cut, finished, folded, boxed, and shipped on the fourth day. Of course, if things have to go to the dyehouse—we do not operate our own—deliveries will depend on the service we get.

Easier Supervision

There is another advantage, no less important. It is increased ease of supervision. Formerly, located as we were on four floors, it was next to impossible for one man to keep actively in touch with everything that was going on. Today the superintendent can literally be "everywhere at once."

Part of the improvement in speed and quality of production may fairly be attributed, however, to the greater ease of seeing which now prevails. Lighting has been tremendously improved.

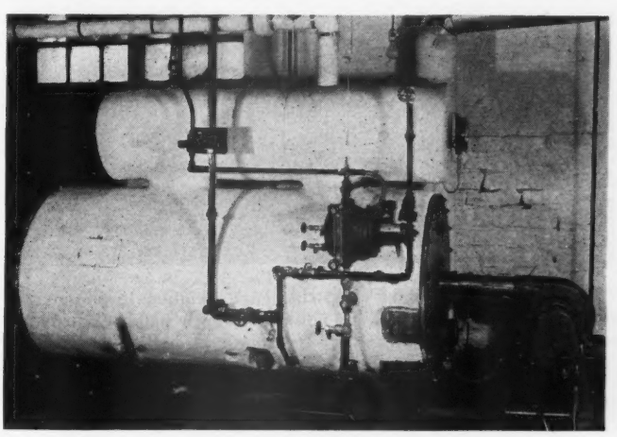
Three rows of building columns, spaced 20 feet apart, split the mill area into four parts. In each row the columns are spaced at 9-ft. intervals. In effect, therefore, the mill is divided into bays 9 by 20 feet. To each bay there are two lighting outlets, each covering a working area of 90 square feet. The ceiling is 12 feet high, and lamps of 200-watt capacity are mounted 10 feet off the floor. Reflectors are prismatic glass, which through washing can be restored to their original efficiency—an important point in a textile mill with so much lint flying around.

It should be mentioned, too, that the ceiling is newly painted in a flat mill white which possesses a high reflection value and adds accordingly to the overall effectiveness of the general lighting.

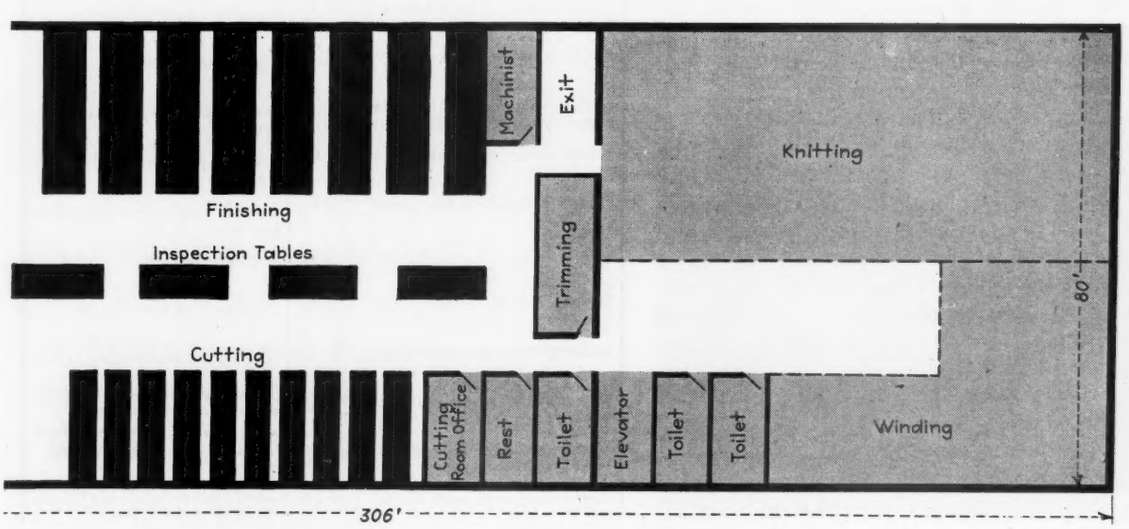
As a result, cutters at the bench, operators at their machines, are working at an intensity which actually reaches 25 foot-candles at working areas, without the supplementary local illumination generally so badly needed. Each light, incidentally, is individually controlled, and although it may take some time and a good deal of extra current to educate operators to switch lights on and off as needed, the extra cost will, we feel, be far outweighed by the definite advantages of greater production and better quality.

Two other things have helped to give us the flexibility so necessary today. One is a surplus supply of machines which are stored on the floor above the manufacturing area. Thus, if a machine is down for repairs and production is "waiting on" it, it can be replaced by another at short notice. Also, production lines can be quickly shifted to conform to seasonal demands.

The second is an automatic boiler of the Scotch horizontal type which supplies process steam far more cheaply than the main heating plant could hope to do, and which in summer leaves us quite independent of the latter. It supplies 75-lb. steam for steaming and pressing, and builds up the required pressure in the morning in about ten to fifteen minutes' time, depending on the temperature of the water in the city mains. As steam is used during the day and the pressure drops down to 65 pounds, the oil boiler kicks on automatically and in less than two minutes brings the pressure back again to 75 pounds. We don't know what we'd do without it.

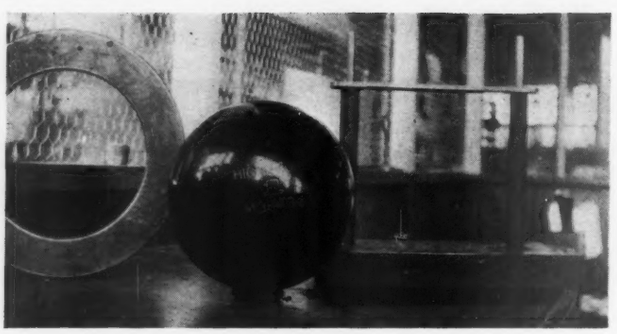


From four floors to one has meant quicker deliveries, smaller inventories, better supervision—in short, a better product at lower manufacturing cost. The oil burner does its part in guaranteeing the flexibility so necessary today. It supplies process steam and leaves the production department quite independent of the main heating plant



Two Spendthrifts Get Fired

Motion study takes "Make Ready" and "Clean Up" off the inspection payroll



Gaging bowling balls. Old ring gage weighed 16 pounds; was held by hand. With new gage, both bands are free to roll ball under crossbar. If bar moves, ball is oversize. Removable shim permits gaging of minimum sizes. Better inspection, less effort.

OUR INSPECTORS had heard a great deal about a money waster called "Make Ready" and his partner, "Clean Up." Motion-minded foremen told them it was a cinch to get rid of these two spendthrifts and that the money saved looked nice on the monthly report. A hasty survey showed that both of these fellows were on the inspection payroll. In fact, they started and ended every inspection job.

The inspectors also heard that it was foolish to use one of the hands as a holding device. Suddenly they discovered that inspectors' left hands were apparently designed by nature as holding devices. Someone delicately hinted that "evolution of the species" might eventually convert their left hands into some sort of vise or clamp. To save the race from such a fate, the inspection group leaders investigated this management tool called "motion study," and decided to hold a motion study meeting one night a week.

After several weeks' study of the basic theories involved, and after viewing film loops showing applications by foremen and operators in other departments, the inspectors were eager to "show their stuff."

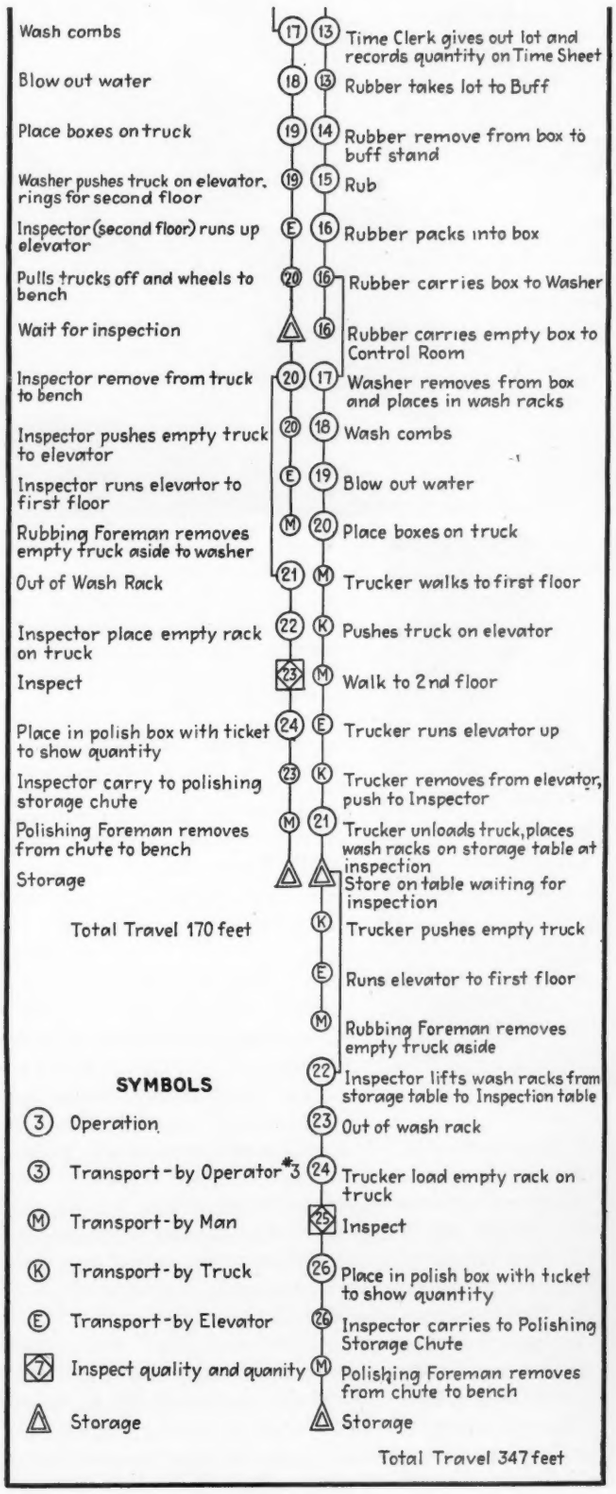
Arrangements were made to meet each week in a dif-

PROCESS CHART SHOWING NEW AND OLD ARRANGEMENT OF COMB INSPECTION AFTER SAWING

New Method			Old Method
Saw	1	1	Saw
Pack in large box	2	2	Pack in large box
Sawyer deliver to blower	2	2	Sawyer deliver to blower
Storage at air cleaning bench	△	△	Storage at air cleaning bench
Blower take out of large box	3	3	Blower take out of large box
Blow out dust	4	4	Blow out dust
Blower replace in large box	5	5	Blower replace in large box
Blower load box on truck	6	5	Blower carry to inspector in large box
Blower push on elevator	6	5	Blower walk back to air cleaning bench
Blower run elevator to first floor	E	6	Inspector remove from large box
Inspector take truck off elevator	7	7	Inspect
Inspector place empty truck on elevator, ring bell for blower	7	8	Inspector pack several kinds in each large box on floor as received from blower
Blower run up elevator	E	8	Trucker load on truck
Blower remove empty truck	6	K	Trucker push to elevator
Inspector remove from box	7	E	Trucker runs elevator to first floor
Inspect	8	M	Trucker walk to first floor
Inspector place in rubbing box with ticket to show quantity	9	K	Trucker remove from elevator
Inspector places rubbing box on table in control room	10	K	Truck to Control Room
Empty boxes on truck	11	10	Pile boxes on floor
Clerk gives out lot and records quantity on time sheet	12	11	Trucker pile empty boxes on truck
Rubber takes lot to buff	13	K	Trucker push empty truck to elevator
Rubber remove from box to buff	13	K	Trucker push empty truck on elevator
Rub	14	M	Trucker walk to 2nd floor
Replace in box	15	E	Trucker run elevator up
Rubber carries box to washer	15	K	Trucker remove empty truck
Washer removes from box to wash racks	16	K	Push empty truck to inspector and repeat for each load
Washer deliver empty rubbing boxes to sawing inspector	16	11	Control room clerk removes boxes from floor, sorts out in pidgeon holes by kind of comb
Washer return to wash bench	16	12	Control room clerk makes up lots, several kinds per lot by type of finish and packs in rubbing boxes

William R. Mullee

American Hard Rubber Company
Butler, N. J.


Wash combs
Blow out water
Place boxes on truck
Washer pushes truck on elevator. rings for second floor
Inspector (second floor) runs up elevator
Pulls trucks off and wheels to bench
Wait for inspection
Inspector remove from truck to bench
Inspector pushes empty truck to elevator
Inspector runs elevator to first floor
Rubbing Foreman removes empty truck aside to washer
Out of Wash Rack
Inspector place empty rack on truck
Inspect
Place in polish box with ticket to show quantity
Inspector carry to polishing storage chute
Polishing Foreman removes from chute to bench
Storage
Total Travel 170 feet
13 Time Clerk gives out lot and records quantity on Time Sheet
13 Rubber takes lot to Buff
14 Rubber remove from box to buff stand
15 Rub
16 Rubber packs into box
16 Rubber carries box to Washer
16 Rubber carries empty box to Control Room
17 Washer removes from box and places in wash racks
18 Wash combs
19 Blow out water
20 Place boxes on truck
21 Trucker walks to first floor
22 Pushes truck on elevator
23 Walk to 2nd floor
24 Trucker runs elevator up
23 Trucker removes from elevator, push to Inspector
21 Trucker unloads truck, places wash racks on storage table at inspection
Store on table waiting for inspection
Trucker pushes empty truck
Runs elevator to first floor
Rubbing Foreman removes empty truck aside
22 Inspector lifts wash racks from storage table to Inspection table
23 Out of wash rack
24 Trucker load empty rack on truck
25 Inspect
26 Place in polish box with ticket to show quantity
26 Inspector carries to Polishing Storage Chute
Polishing Foreman removes from chute to bench
Storage
Total Travel 347 feet
SYMBOLS
3 Operation
3 Transport - by Operator
M Transport - by Man
K Transport - by Truck
E Transport - by Elevator
Inspect quality and quanity
Storage

ferent inspection department. It was great sport to point out all the applications possible in the other fellow's department, but it was all taken in a friendly spirit. Ideas worked out in one place were often adopted in another. This was particularly true of holding devices for mounting gages to permit free use of both hands. A few of the applications are shown in the pictures.

An excellent application of the "process chart" was made in the inspection after comb sawing. Both old and new methods are shown in the chart illustrated.

Through the process chart the idea of making a change was sold to the management, and an appropriation of $600 was made to install a dumbwaiter next to the air-cleaning bench and to prepare an inspection workplace in the control room on the floor below.

From Kind of Comb to Type of Finish

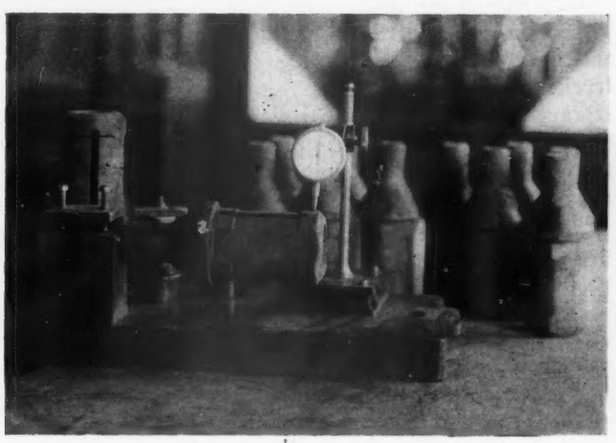
Formerly a control room clerk unpacked the boxes of combs as received from inspection and sorted on shelves by *kind of comb*. Later, combs were packed in rubbing boxes by *type of finish* for the rubbing operation. Each type of finish required a different combination of buffs. This grouping by type of finish was done to keep buff changes down to a minimum. Under the new method, the inspector has a chart to guide her in packing directly by *type of finish* into the rubbing boxes. In this manner, the "clean up" on her job has been combined with the "make ready" for the rubbing operation, thus eliminating the clerk formerly required to sort out the lots.

Under the old plan most of the handling was done by a trucker. With the new layout, distances have been shortened so that the operator can push the truck a few feet to the next operation. Distance traveled has been cut in half and a trucker eliminated.

Experiments on eye fatigue with colored backgrounds led to the selection of a pale blue for the inspection workplace. This made a high color contrast with the glossy black combs, reducing the eye strain and improv-

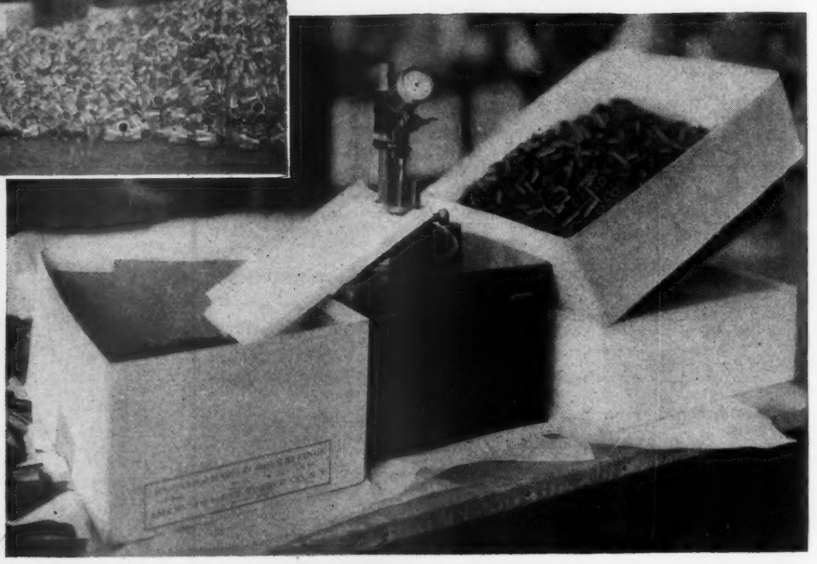
Process chart led directly to new inspection method. Now the operator combines "clean up" on her job with "make ready" for buffing

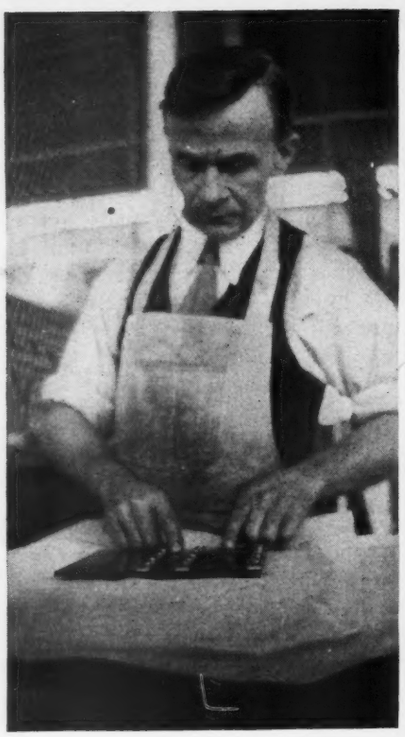
Three dimensions gaged in one handling. Gages held in a fixture; both hands free to move pieces



Again, in gaging inside diameter of bushings, gage is held in fixture. Duplicate supply boxes, duplicate gages, both hands used simultaneously. Two-day job gaged in one day. Fixture cost 10 cents

Inspection for length. Short carry from box to gage. Eyes watch pointer. Both hands slide pieces under gage. Drop delivery





One "get ready," one "clean up" saved by using adjustable flat gage to check flat articles plus or minus in single handling

Inspector places inserts in pressman's rack, insures definite count. Rack prevents damage in trucking. "Clean up" of inspection through pre-positioning is "get ready" for pressman

ing greatly the quality of inspection.

With the closer relation between inspection and the next operation, and by eliminating the storage for trucker on the floor above and storage in the control room, there is a considerably smaller inventory of work in process. There is a better control of stock by eliminating the tendency to pile a new lot on top of an old one. The inspection count for the sawing operation is placed directly on the lot going to the rubbing operator, thereby eliminating any recounting and possible clerical errors.

Now there is less congestion in the trucking aisles in the sawing department, since the straight-line flow from sawing to inspection cuts a new path and eliminates storage as well as back-and-forth travel. A large amount of badly needed floor space was made available in the sawing department, and by eliminating the storage shelves in control room, ample space was provided for the inspectors at this point.

Summing up the results achieved, we find:

1. One trucker released for other work.
2. One lot sorter transferred to another operation.
3. Eye fatigue reduced, quality of inspection improved.
4. Smaller inventory in process.
5. Better control of count.
6. Saving in floor space.

These savings have been made by studying the "Make Ready" and "Clean Up" of the inspector's job as related to the job ahead of and the job following inspection—fertile ground for motion study that is often overlooked in ordinary time-study applications.

The Normal Stock Method of Valuing Inventories

William F. Burke

Chief Accountant
Scovill Manufacturing Company
Waterbury, Conn.

IN THOSE lines of business where it is necessary to carry large inventories, fluctuations in prices of materials have an important bearing on the profits or losses shown. When prices are rising, large inventory profits are made; when prices are falling, corresponding inventory losses are incurred. When prices are rising, it usually happens that business is good and profitable; when prices are falling, business is poor and unprofitable. Thus the conventional method of evaluating inventories at cost or market, whichever is lower, helps to swell profits in good years and to augment losses in poor years. Not only does this process exercise an unfavorable psychological influence on managers, stockholders, and the general public, but also, under the recent income tax laws which prohibit both consolidated returns and the applying of losses of one year against the profits of the following year, it may cause business to pay the full income tax rate on fictitious inventory gains without any deduction of inventory losses.

How It Works on Brass

Since the normal stock method of evaluating inventories has been used to some degree in the brass industry* for decades, I will use that industry as an illustration.

In a brass mill two basic materials, copper and spelter (zinc), account for 95 to 99 per cent of the total weight of the inventory exclusive of coal and general supplies. It is necessary to have large quantities of these materials and their alloys on hand, and the turnover rate of the total stock is low.

Under these conditions, normal inventories are in many respects similar to fixed assets. If a brass mill is to continue in business, the copper and spelter inventory is just as essential as the furnaces in which it is melted and is even more permanent. If the replacement cost of the furnaces increases, the increment of value is not taken into profit and loss. The normal stock theory requires that basic materials be treated like the furnaces—that is, if the replacement cost increases, the increase in value is not taken into income. When a given quantity of materials is priced at the end of the year at the same price as the first of the year, the operating results are not distorted.

This idea is well expressed in the following passage from the June 30, 1932, report of the American Smelting and Refining Company:

> An amount of each metal in process is as necessary to the conduct of business as the smelting and refining plants themselves, and your company has accumulated the amount of each metal it must have in process under normal conditions, which resembles a reservoir. It endeavors to sell each day from the outgoing end of the reservoir an amount of each metal equal to that taken in at the incoming end. The metal content of the reservoir is known as normal stock. Variations in the price of the normal stock are as immaterial from year to year as are variations in the price of land upon which a plant is situated, for the reason that it will only be at the end of the company's activities that such variation will be of any practical consequence.

In order to give an example of how the normal stock theory works, suppose it is decided that for normal operations a minimum inventory of 10,000,000 pounds of copper and 5,000,000 pounds of spelter is required, and that it will be priced at approximately the lowest prices of the recent depression period, 5 cents a pound for copper and 3.5 cents a pound for spelter. The value of this portion of the inventory is therefore as follows:

Copper, 10,000,000 lb. @ 5c	$500,000
Spelter, 5,000,000 lb. @ 3.5c	175,000
	$675,000

This inventory is set aside in a separate account on the books and thereafter it is never touched; purchases are added to the excess inventory account at the prices paid, and sales are deducted at cost.

Direct Comparison

Now assume that on December 31, 1933, and for the next three years the actual inventories are as stated in Table I. (The prices for December 31, 1933, are market. If costs were lower, cost prices would be used.) This table shows the value that would be placed on each inventory using the cost-or-market method. Table II shows the same inventory with the value calculated by the normal stock method. In this table the "excess stock" value is never changed. By the normal stock method the inventory value at the end of 1933 was $387,500 less than the value obtained by the cost-or-

*It had been customary to value all copper in the inventory at 10 cents a pound and spelter at 5 cents a pound up to 1931 when market prices went below these figures.

TABLE I—Inventory Values at Cost or Market, Whichever Is Lower

Date	Pounds in Inventory—Copper	Pounds in Inventory—Spelter	Prices—Copper	Prices—Spelter	Inventory Value
Dec. 31, 1933	11,000,000	5,500,000	8.25c	4.75c	$1,168,750
Dec. 31, 1934	13,000,000	6,500,000	14	7	2,275,000
Dec. 31, 1935	14,000,000	7,000,000	16	8	2,800,000
Dec. 31, 1936	11,000,000	5,500,000	5	3.5	742,500

TABLE II—Inventory Values According to the Normal Stock Method
(Same total tonnages as in Table I and same prices for excess stocks)

	Pounds Excess Inventory—Copper	Pounds Excess Inventory—Spelter	Inventory Value—Excess Stocks	Inventory Value—Normal Stocks	Inventory Value—Total
Dec. 31, 1933	1,000,000	500,000	$106,250*	$675,000	$781,250
Dec. 31, 1934	3,000,000	1,500,000	525,000	675,000	1,200,000
Dec. 31, 1935	4,000,000	2,000,000	800,000	675,000	1,475,000
Dec. 31, 1936	1,000,000	500,000	67,500	675,000	742,500

*Copper..... 1,000,000 lb. @ 8.25c $82,500
Spelter..... 500,000 lb. @ 4.75c 23,750
$106,250

TABLE III—Operating Profits Obtained by Both Methods

Year	Profits According to Cost-or-Market Method	Reserves Provided by the Normal Stock Method—Total	Reserves Provided by the Normal Stock Method—Change	Profits According to the Normal Stock Method
1933.....	$537,500	$387,500	+$387,500	$150,000
1934.....	987,500	1,075,000	+ 687,500	300,000
1935.....	550,000	1,325,000	+ 250,000	300,000
1936.....	1,275,000†	.....	—1,325,000	50,000
Total	$800,000			$800,000

†Loss

market method. If it is desired to give stockholders full information regarding inventory value, it is recommended that the inventory on December 31, 1933, be reported to stockholders somewhat in the following manner:

Inventory at cost or market, whichever is lower.....$1,265,000
Less reserve..... 387,500
$877,500

Table III shows the reported profits according to both theories. It is apparent that the normal stock method produces a more even profit trend. The profit for the four-year period by the cost-or-market method is subject to wide fluctuations due to market prices, but the total net profit for the period is exactly the same as that produced by the normal stock method. Of course, if prices on December 31, 1936, were different from those used in pricing the normal inventory, the results for the four-year period would be different, but this in no way affects the soundness of the theory.

The normal stock method thus gives a truer picture of operating profits not only yearly, but also monthly. If this method is not employed when the inventory is large and prices are rising, the increase in price is reflected in sales quite promptly, but it takes considerable time for the low-priced inventory to be moved before the higher-priced purchases can be charged to cost of sales. Meanwhile the margin of profit shown on the books is exceptionally high and in my opinion overstated. When prices are falling, the high-priced inventory will be charged to cost of sales long after the lower prices affect sales, and discouraging losses will be shown. The normal stock theory, on the order hand, moves the higher-priced materials into cost of sales more quickly because all transactions are through the excess stock inventory account; consequently there is a closer correspondence of price levels in the sales and cost-of-sales figures.

It is conceivable that actual quantities in the inventory may temporarily drop below the normal stocks. At such a time it is probable that the shortage in normal stocks is more than covered by contracts to purchase materials. Whether or not this is so, the amount sold from normal stocks will be priced at market, charged to cost of sales, and credited to reserve for inventory purchases. The latter may be shown as a deduction from the normal stock inventory account.

The normal stock method of inventory taking has never been approved by the Internal Revenue Bureau and therefore cannot be used in income tax statements. In fact, it is expressly prohibited by Article 102 of the current income tax regulations.

If the normal stock theory were accepted by the income tax authorities, there would be enormous savings in taxes to concerns with large inventories of basic raw materials. Reverting to the illustration given above, the income tax as applied now would be levied on total income of $2,075,000 during the four-year period, whereas the real income was only $800,000. Concerns in this position have a real basis for complaint against the incorrect determination of income prescribed by the Internal Revenue Bureau.

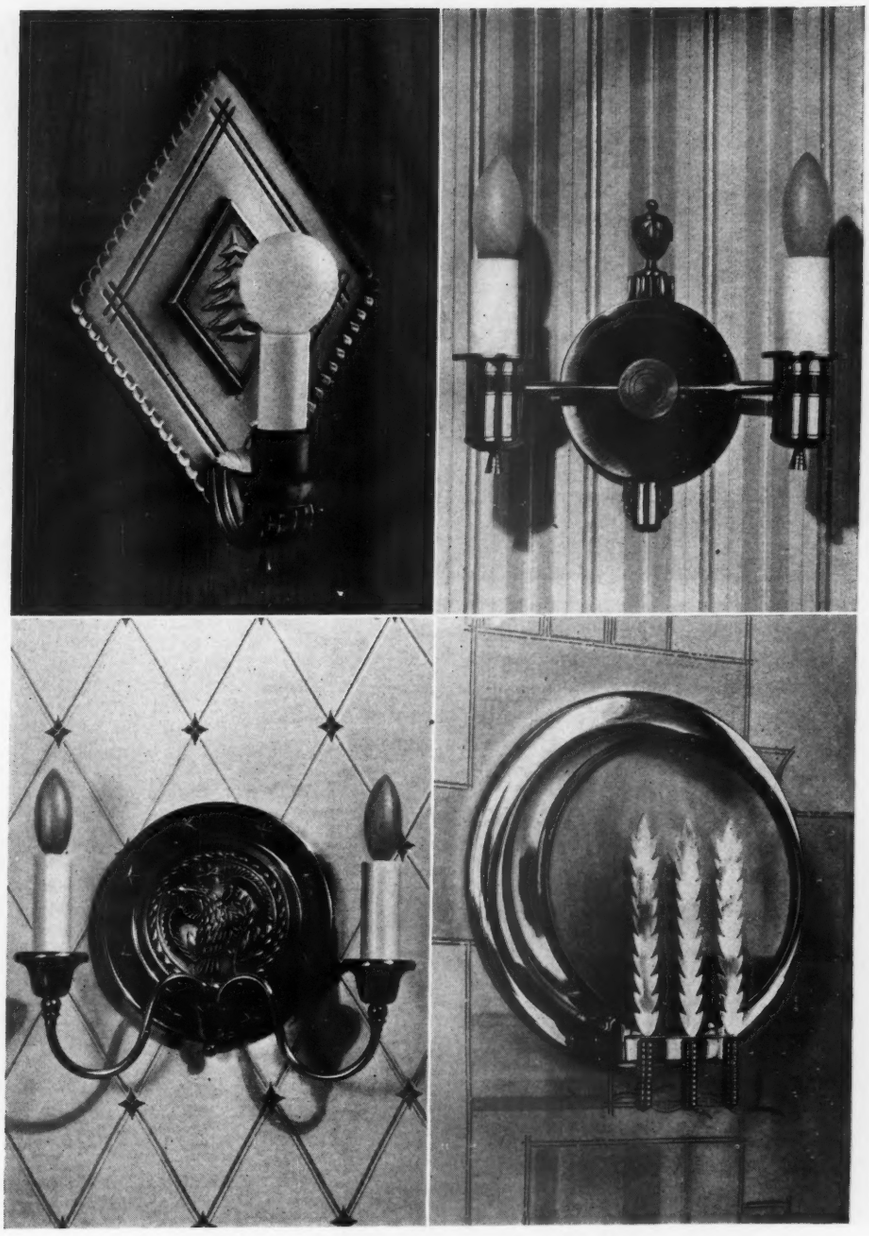
The Tax Angle

Tax benefits, however are not one-sided. One of the greatest faults of the income tax is that the yield varies greatly from year to year and requires the imposition of emergency taxes in periods of depression. As the normal stock theory gives a more even level of corporate income, so it gives the government a more dependable source of revenue from income taxes.

The normal stock method may be difficult or even impossible to apply in those industries that have a wide assortment of materials in their inventories, but it seems quite practical in such industries as copper, brass, lead, rubber, steel, oil. Because it gives a truer statement of operating profits, it is not so likely to lead to extravagances, excess dividends, and impairment of real working capital in periods of rising prices. It can be used as the basis of inventory control and is an aid in working out efficient purchasing methods. It leads to more conservative policies which most surely enable business to carry on more successfully.

Design

can make products look custom-made and expensive even when they are mass-produced and modestly priced



● Chosen at random from a line of inexpensive Early American (1620-1740) fixtures announced a short time ago by Chase Brass and Copper Company. This sconce is typical of the craftsmanship of the itinerant tinsmiths of Colonial days. It's of wrought brass in an antique tin finish. The pine tree motif in antique brass is from the famous Massachusetts pine tree shilling

● Even the modest home-owner can have Georgian (1740-1800) fixtures if he wants them. This one gets its authenticity from the urn, drapery swag, and fluted columns so much used by the Georgian school of design. Back plate and candle cups are wrought brass; forgings in brass; finish in antique brass and black

● One of a group of Federal (1770-1840) fixtures. Expert die-making has retained in the silver reproduction of the Salem eagle the careful modeling which made the original wood carving a museum piece. Backplate and cups of wrought brass; bracket finished in antique brass; background for stars either dull or glazed black

● For new-fashioned folks, the Classic Modern (1934-). A reflector-like frame supports a convex glass disk, acid-etched inside and out, and provides background for the stylized feathers. Finished in polished chromium. When people start building houses again, authentically designed lighting fixtures will be waiting for them

Never has design meant more to the factory operating man than now.

Nothing sells goods quicker.

So, when a concern does an extra good job of designing a line of products, the editors want factory operating men to know about it.

That's the why of the four photographs shown on this page.

Of course *you* haven't a line of lighting fixtures to do over—or even to do. But don't tell us you haven't some product that needs some of the good looks, authenticity, or what not which only a good job of design can give it.

Incidentally, when the President gets around to his home-building program here's one concern that will be ready.

Engineers and designers at work in the IBM air-conditioned laboratory—a typical department

Conditioned Air for Engineers

Better, faster work and healthier employees because working conditions are right

INTERNATIONAL Business Machines Corporation, Endicott, N. Y., has more than 200 engineers for production and research. A few months ago these engineers were moved into a new building where they have the advantage of conditioned air.

Some results of performance in this air-conditioned building as compared to performance in buildings without this feature are available. They show faster, higher quality work, better moral, healthier employees. A check-up in the drafting room and in the experimental machine shop revealed that the work had been speeded up to a marked extent.

The air-conditioning system serves every part of the building with the exception of the paper testing laboratory, which is equipped with a separate system. A 45,000-c.f.m. fan circulates the heated or cooled, dried or moistened air through the building at the rate of three and one-half changes per hour. The air travels to the different rooms in ducts and returns to the conditioning equipment through the corridors. As the returning air re-enters the conditioning equipment it is met by 20 per cent outside air, making the composition of the air in the building always 80 per cent recirculated and 20 per cent from the outside. The outside air intake is provided with heating coils in which steam circulates in the colder seasons to preheat the incoming air.

To trace the path of the outside and recirculating air as it enters the conditioning equipment, it first passes through removable paper filters to eliminate dust and other impurities; then moves successively through water-cooled coils and steam-heated coils. To meet different weather conditions, either or both of these coils may be in operation.

The cooling coils are a part of the surface-coil cooling system used. In this system the air is dehumidified by condensing the moisture directly from the air by contact with the cooling coils. The circulating water is cooled in a shell tube cooler in which the brine of the refrigeration system circulates.

In hot weather only the cooling coils are used, but on cold, damp days both coils are used—the cooling coils to remove the dampness, followed by the heating coils to raise the temperature.

After heating or cooling, or both, the air passes through a water wash, in which the water is introduced in a fine spray through atomizing jets. This spray is in operation only when it is necessary to humidify the air. From the washer the air passes through the 45,000-c.f.m. fan, from which it is distributed through ducts to the rooms.

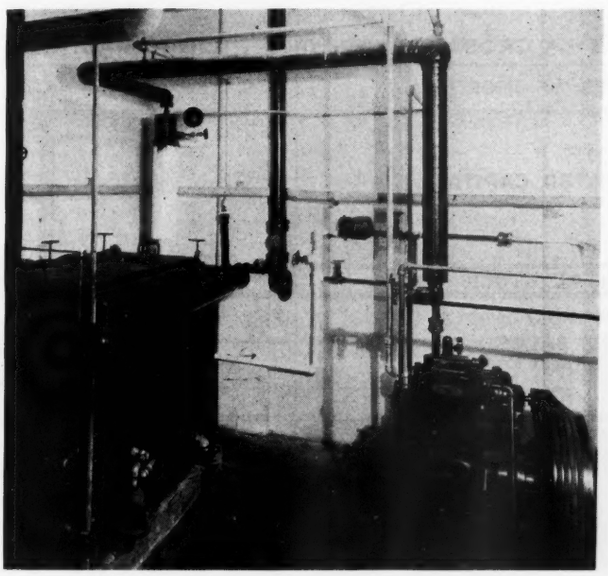
At the mouth of each duct outlet are mounted a

booster heater and a damper for individual room control. A separate control panel is furnished in each room, provided with a thermostat that automatically controls the amount of steam fed to the booster heater, and a dial showing air pressure at the duct mouth, indicating the position of the damper. In winter, both heater and damper are used to raise and lower the temperature respectively, whereas only the damper is used in summer. The air arrives at the room from the main conditioning system at a temperature of 68 to 72 degrees Fahrenheit, and at 40 to 50 per cent relative humidity. Desired variations in the condition of the air circulating in each room are then made by setting the room thermostat controlling the booster heater and position of the damper to suit.

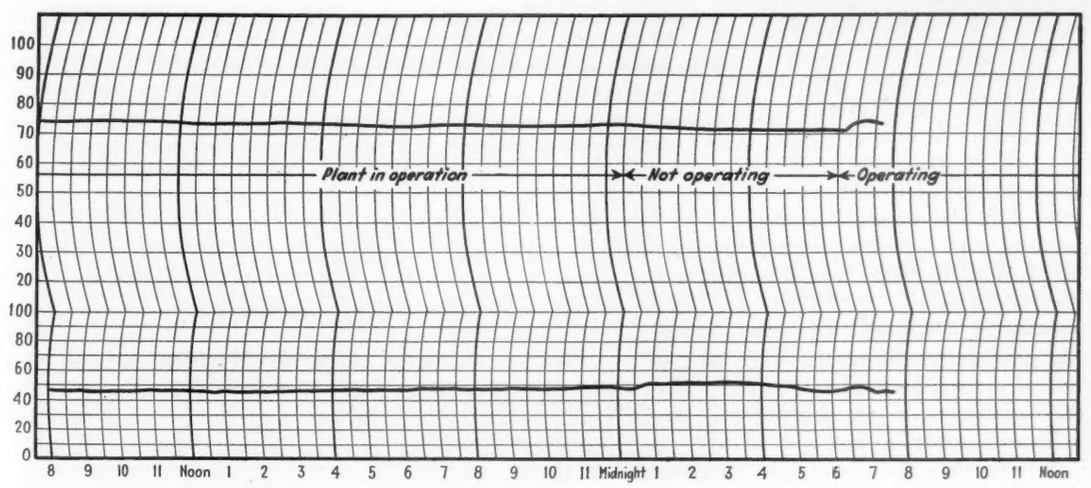
The system is guaranteed to maintain a maximum temperature of 74 degrees Fahrenheit and a minimum humidity of 50 per cent in the colder seasons. In summer it is guaranteed to maintain a temperature ten degrees lower than the outside atmosphere, and a minimum humidity of 50 per cent. The accompanying chart shows how closely temperature and relative humidity are held to their set values in actual test.

Fully automatic control of the main conditioning unit is obtained by means of a thermostat and hygrostat which actuate air-operated valves. These valves automatically cut in and out, or vary, the flow of brine, steam, or water according to their settings. The main fan runs at two speeds—high speed by day, low speed at night. The hygrostat measures humidity by difference in readings of dry and wet bulb thermometer. The control is so sensitive that it operates in response to weather changes and a change in room temperature of one degree Fahrenheit.

Exhaust steam at 2-pound pressure is used for all heating coils. An 83-ton ammonia compressor refrigerates the brine which is circulated by a $7\frac{1}{2}$- hp. pump. The compressor is located in a separate room provided with an individual fume exhaust system to eliminate the danger of injurious ammonia fumes in case of leakage. A $\frac{1}{4}$-hp. air compressor furnishes the air for operating the thermostatically controlled valves. Metal parts subject to corrosion—ducts, coils, and casings—are constructed of aluminum because of its durability and noncorrosive properties.



Above, part of the equipment which supplies conditioned air for the paper testing laboratory. At right, one of the individual control boards. The chart, below, shows how close temperature and relative humidity are held to their set values in actual test



There Is an Economic Right Price for Every Product

Supporting the hypothesis that an unprofitable business is a social evil

W. L. Churchill

Vice-President
John R. Hall Corporation
New York

(Last month the principles upon which the author bases his "Economic Right Price" were established, and the assembling of the elements entering into that price was begun. Now the remaining elements, except the cost of distribution, are added.—Ed.)

HAVING found the service cost of a given product our next step in the process of determining its economic right price is to figure what is ordinarily called the profit. Here again we depart from conventional accounting by considering profit an essential part of the cost, instead of something to be tacked on.

35 Profit Views

Before proceeding, I submit, as evidence that most manufacturers have only the vaguest idea of what constitutes profit, Table I, which shows that 87 representative American firms had 35 ideas as to profit. How can prices fair to anyone be constructed on bases so widely spread?

I submit, also, Table II, to show that it is impossible to determine right prices by means of the most meticulously kept cost accounting systems. Here the grand result is fifteen different costs, which would form the basis of fifteen different prices. Is it possible to secure costs, and therefore prices, which are fair to all producers in an industry and also their customers By such method?

In figuring Profit, let us first drop that term, since no one knows exactly what it means, and a large part of the public regard it as synonymous with "plunder." Let us, rather, use the expression, "Cost of Progress," and determine what elements must be included in a firm's prices if it is to continue to survive and make progress.

TABLE I – A CROSS-SECTION OF PRICING PRACTICE★

BASIS OF PROFITING	NUMBER REPORTING	RATE
INVESTED CAPITAL	3 1 2 2 16 8 1 4 2 39	7% 10 12 12.5 15 20 22 25 30
CAPITAL STOCK	2	10
GROSS SALES	1 1 1 6 1 2 1 13	5 7 8 10 15 20 25
NET SALES	1 4 5 3 2 1 1 2 2 21	7.5 10 15 20 25 25.5 30 33.3 35
TOTAL COSTS	1 1 3 1 6	10 20 25 30
MANUFACTURING COSTS	2 1 3	10 90
LABOR COSTS	1	112
MAN HOURS	1	50 cents an hour
MACHINE HOURS	1	50 cents an hour
9 BASES	87 FIRMS	35 RATES

★ *A recapitulation of the replies of members of 3 manufactures' associations*

Wages to Capital

First, we must pay wages to useful capital, based on the current market price of money. To the "Service Cost," which was explained and shown graphically in last month's article, we now add, as shown in Figure 4, "Wages to Capital."

Development, Research, and Expansion

Second, we must include something for "Development, Research, and Expansion," thus adding another element to "Cost of Progress," as shown in Figure 4. This is just as necessary for the smallest concerns as for the General Electric Company, the only difference being that the small concern does not realize how much development and research it actually carries on and usually fails to allot specific funds for the purpose.

Contingencies and Obsolescence

Next, we must take care of the business's normal expansion, with reserves for contingencies and obsolescence, and how we do so is explained under "Cash Surplus."

Cash Surplus

Reserves for normal expansion can be quite definitely set, as studies of American business that have lasted several generations show a regular growth of 7½ per cent per annum. So we now add the surplus, but show it with reserves for contingencies and obsolescence included, since these items must come out of the cash surplus. Again see Figure 4.

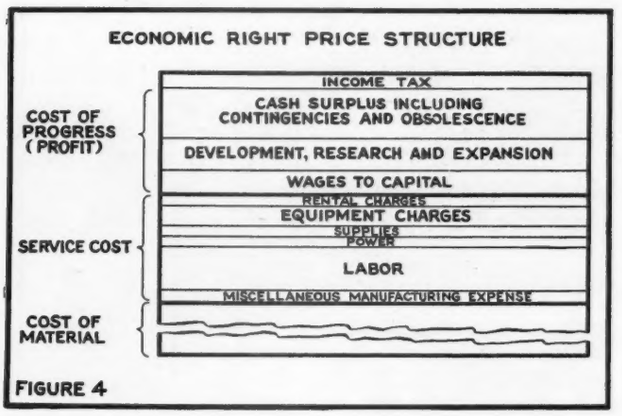


FIGURE 4

The items, "Wages to Capital," "Development, Research and Expansion," and "Cash Surplus, including reserves for Contingencies and Obsolescence," taken together, constitute the "Cost of Progress."

The Cost of Progress should at least equal the Service Cost. In other words, if the Service Cost of a product, (excluding materials) is $1, then that part of its price which we have discussed so far must be $2, plus cost of materials at the time of shipment.

This very convenient figure for the Cost of Progress, namely, 100 per cent of the Service Cost, seems arbitrary. But there is nothing arbitrary about it. Figure the necessary costs of survival and progress with the greatest care for any given case, or work backward with the figures compiled by firms which have survived and made progress, and it always comes out just about the same.

Put it this way: When a concern adds an amount equal to its normal service costs in figuring its prices, it has added the minimum amount that will permit it to survive and progress. This is necessary from the standpoint of the company, and it is entirely equitable from the standpoint of the consumer.

Income Tax

Since we have figured what is ordinarily called "profit" at this point, we must not forget a little item that goes along with profit—namely, Income Tax. The corresponding panel, shown in Figure 4, is made accordingly.

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In the concluding article, to be published next month, the author will complete the price structure by adding the cost of distribution, and will discuss the effect of operation with distribution costs that are too low.—Ed.

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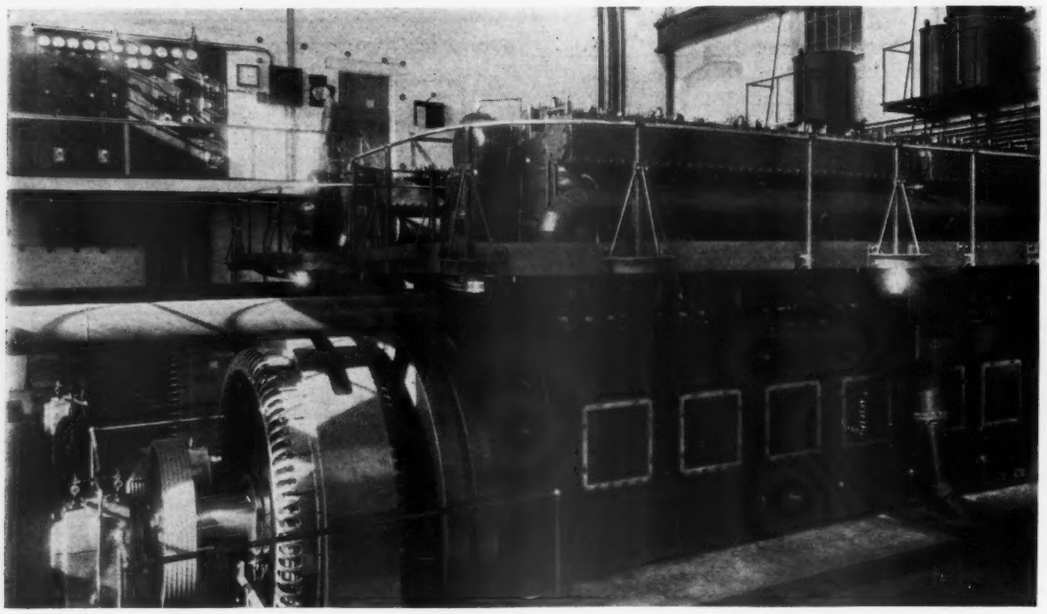
TABLE II — THE WOOL INSTITUTE, INC.
COMPARATIVE CONVERSION COSTS OF ¼ BLOOD TOP AND 22's COUNT OF YARN AT 60% TO 140% CAPACITY, INCL.

CLASS OF EXPENDITURE	HIGH		LOW		MEAN	
	CENTS	%	CENTS	%	CENTS	%
TOPS						
Direct Labor						
Scour	0.0015		0.0020		0.0023	
Card	0.0060		0.0034		0.0021	
Comb	0.0092		0.0093		0.0190	
OVERHEAD	(0.0167		0.0147		0.0234)	
Indirect Labor						
Scour	0.0006		0.0007			
Card	0.0025		0.0032		0.0052	
Comb	0.0038		0.0044		0.0077	
Miscel., labor	0.0040		0.0083		0.0117	
Administrative labor	0.0072		0.0046		0.0091	
Changing	0.0019		0.0072		0.0084	
Partially changing	0.0187		0.0130		0.0202	
Unchanging	0.0012		0.0020		0.0015	
Total overhead before depr'c'n.,	0.0399		0.0434		0.0638	
Total cost before depreciation	0.0566		0.0581		0.0872	
Depreciation	0.0143		0.0103		0.0172	
Total conversion cost after depreciation	0.0709		0.0684		0.1044	
YARN						
Direct Labor						
Draw	0.0381		0.0229		0.0402	
Spin	0.0278		0.0209		0.0227	
Twist or wind	0.0474		0.0218		0.0310	
Reel and examine	0.0138		0.0202		0.0192	
OVERHEAD	(0.1271		0.0858		0.1131)	
Indirect Labor						
Draw	0.0088		0.0050		0.0013	
Spin	0.0321		0.0159		0.0330	
Twist or wind	0.0063		0.0034		0.0052	
Reel and examine	0.0018		0.0024		0.0016	
	(0.0490		0.0267		0.0511)	
Miscel., labor	0.0174		0.0131		0.0160	
Administrative labor	0.0317		0.0088		0.0171	
Changing.	0.0142		0.0142		0.0121	
Partially changing	0.0383		0.0129		0.0124	
Unchanging	0.0053		0.0027		0.0028	
Total overhead before depreciation.	0.1559		0.0784		0.1115	
Total conversion cost before depreciation.	0.2830		0.1642		0.2246	
Depreciation	0.0351		0.0126		0.0243	
Total Conversion Cost of Yarn After Depreciation		*		*		*
At 60 % Capacity →	0.3505	+27.5	0.1925	-30.0	0.2755	Mean
At 80 % " →	0.3181	+27.5	0.1768	-29.0	0.2489	"
At 100 % " →	0.2926	+26.0	0.1675	-28.2	0.2335	"
At 120 % " →	0.2806	+24.8	0.1626	-22.8	0.2249	"
At 140 % " →	0.2721	+24.1	0.1591	-27.4	0.2188	"

* Per Cent plus or minus as compared to mean cost



Operating cost data for these two diesel engines are given in the table on the next page. The engines are rated 1,000 b.hp. each and are installed in a cotton textile mill

What About Diesels?

Oil engines have won an important place both as main power units and in auxiliary service

Oliver Field Allen
Consulting Engineer, New York

INTERNAL combustion engines have been used in industrial plants for more than 50 years. The first type was a gas engine, but with the advent of the diesel the oil engine has grown steadily in popularity. Gas engines are still used in a few localities where gas is cheap, and some gasoline engines are employed where the power requirements are small or intermittent.

At first made only in small sizes, the ratings of oil engines have increased rapidly. Before 1915 there were few as large as 1,000 b.hp. Now units of more than 20,000 b.hp. rating are in regular service. Along with the increase in size of diesel units there have come many improvements in design, and the development of several different types.

Until recently the diesel engine was looked upon as belonging to a fixed power plant, and only a few portable or semi-portable plants were built. This was partly due to the fact that the oil engine replaces the complete steam plant. The steam plant burns fuel in the boiler and delivers steam to the engine. The diesel engine burns the fuel directly. This fact should not be overlooked when comparing the two types of power generation.

During the past few years there has been a marked improvement in the light-weight, high-speed diesel of the automatic type, along with a steady reduction in the weight of all types. Thirty years ago diesel engines weighed more than 500 pounds per brake horsepower. Today, very large engines weigh less than 200 pounds per brake horsepower, and there are many reliable power types ranging between 60 and 150 pounds. The automotive type suitable for plant service ranges from about 50 pounds down to 25 pounds per brake horsepower. That this type is not extreme in the matter of light weight will be realized from the fact that diesels for trucks, buses, and motor boats now weigh from 10 to 25 pounds per brake horsepower, with aircraft engines weighing less than 2 pounds.

Diesel engines now available can be classified roughly into three groups. Considering the latest development first, there is the small, high-speed diesel which requires little more attention than automotive engines, and starts as easily. Generally speaking, in this automotive-type classification the size of a unit is restricted to less than 100 hp., at speeds between 900 and 1,200 r.p.m. Shorter life and higher maintenance cost than for the slower-speed engines of the power type is implied.

Part of the slower-speed engines may be loosely

Cost of Electrical Energy Generated by 1,000-Hp. Diesel Engines in Cotton Mill

1933 Period	Kw.-Hr. Produced	Kw.-Hr. Per Gal. of Fuel	Costs Per Kilowatt-Hour: Fuel	Lubrication	Labor	Repairs, Supplies, Insurance	Total
Feb. to Dec., Average.	335,518	13.63	$0.0027461	$0.0002551	$0.0008581	$0.0005526	$0.0044126
1934							
January..	336,400	13.5	0.003073	0.000168	0.000719	0.000527	0.004487
February..	405,000	13.	0.003209	0.000129	0.000792	0.000541	0.004671
March....	492,000	12.84	0.003242	0.000145	0.000984	0.000658	0.005029

Note: Fuel oil cost $0.03665 per gallon for the first four months and $0.04165 for the last six months. Cost of lubricating oil varied between $0.447 and $0.5796 per gallon.

grouped as ranging from about 35 hp. minimum up to around 500 hp., not exceeding 500 r.p.m. in speed.

In the third group are the heavy, slow-speed engines operating at speeds on the order of 350 r.p.m. at about 75 hp. output and going down to less than 200 r.p.m. in the large sizes. These engines combine long life with high efficiency, but they are large and heavy as compared with those of the other two groups. Actually, all of these groups overlap to some extent.

All oil engines are usually rated at close to maximum output, and have little overload capacity. They require intelligent attention in the matter of cleaning and lubrication and must be inspected and overhauled periodically. It has been a mistaken idea that oil engines for power plants will give reliable and economical service without the continuous care of responsible attendants.

Progress is being made in the design of automatic protective and control devices. Even in very small plants it is now wise and practicable to incorporate means for stopping the engine automatically upon failure of the lubrication or cooling systems. Engines can be arranged to operate safely for several hours without attention, but full automatic control is still in the development stage and rather expensive, particularly for small plants.

Foundation requirements correspond generally to the

(Continued on advertising page 64)

Factors To Be Studied When Considering Oil Engine Power

1. *Space* (a) For engine
   (b) For fuel storage
   (c) Openings for exhaust connections
   (d) For cooling equipment if water supply is limited
2. *Local Conditions*
   (a) Permits required or ordinances to be observed
   (b) Existing contracts or obligations to be altered
   (c) Protection against noise, vibration and odors
   (d) Water supply 1. Quantity 2. Purity 3. Cost
3. *Fuel* (a) Available local supply
   (b) Quantity delivered at a time
   (c) Storage facilities (assuming 12 to 15 brake horsepower hours per gallon)
   (d) Price per gallon, in tank, on premises
4. *Labor* (a) Is present personnel qualified and ample to operate and maintain proposed new machine?
   (b) Increase or decrease in cost due to changes in pay, hours, or personnel
5. *Power Requirements*
   (a) Horsepower needed
   (b) Plus generator and/or transmission losses
   (c) Hours per day
   (d) Days per year
   (e) Maximum demand on new unit
   (f) Minimum demand
   (g) Duration of (e) and (f)
   (h) Average load and its relation to rated output of proposed engine
6. *Power Transmission*
   (a) Belt or gears
   (b) Direct coupled
   (c) Independent or parallel operation
7. *Heat Balance*
   (a) Changes in heating, processing, or other operations
   (b) Use of jacket water (100 to 140 deg. F.)
   (c) Use of exhaust gases (different temperatures for two- and four-cycle engines)
8. *The Engine*
   (a) Full rating
   (b) Type 1. Two or four cycle 2. Number of cylinders 3. Solid or air injection 4. Compression and working pressures, including brake m.e.p.
   (c) Space limits
   (d) Weight limits
   (e) Preferred speed
   (f) Required speed regulation
   (g) Fuel economy 1. Full load 2. Half load 3. Specifications of oil
   (h) Lubricating oil required
   (i) Safety and protective devices
   (j) Mechanical details
   (k) Ease of repair
   (l) Foundation
   (m) Piping, auxiliaries, erection, and starting
9. *Economic Aspects*
   (a) First cost
   (b) Operating expenses 1. Labor 2. Fuel 3. Others
   (c) Upkeep and repairs
   (d) Fixed charges, including interest, insurance, and reserves
   (e) Savings in power costs
   (f) Value of increased and/or improved service
   (g) Justification for investment

MANAGEMENT SHORTS

If the experience of one refrigerator manufacturer is worth anything, more and more heavy articles will be shipped in containers of high-test corrugated board. Of 1,400 units shipped in that way, none has reached its journey's end in bad shape.

The same concern saved $15 on each of 400 refrigerators shipped to South America. Certain South American countries base import duties on gross weight, and the corrugated cases were just that much lighter.

A thermostatically controlled, electrically heated hot plate, used to heat-seal transparent cellulose wrapping paper at Pitt Bakeries, Inc., Pittsburgh, does away with the need for $8 worth of cellulose tape a week, reduces wrapping time by 12½ per cent, is said to have paid for itself the first 10 days.

Another Pennsylvania bakery —J. B. Carr Biscuit Company of Wilkes-Barre—makes its own gas at prices far below what the city charges. An anthracite gas producer cost $7,500, but it saves $9,000 annually.

Tomatoes ripen better in an air-conditioned room, reports the Morris Fruit & Produce Company, Minneapolis. Not only is there no loss from the "drying out" which is usual under ordinary conditions, but tomatoes actually tend to regain their natural moisture content, remain firm and solid, bring better prices.

Photo-cell control on eight wrapping machines at the American Chicle Company, Long Island City, N. Y., has increased wrapping speed, cut down dealer complaints by furnishing more accurate counts.

And a photo-cell on a scale beam permits automatic filling of steel barrels at New England Alcohol Company's plant, Everett, Mass. When the predetermined weight of alcohol has flowed into the barrel, the deflection of the scale pointer intercepts the cell which, through relays, controls the shut-off valves.

Where rates are based on demand as well as energy, time allotment of plant operations can be made to yield substantial savings. For instance, in an Illinois ice cream plant, the hardening room is cooled and ice is made during shutdown periods, as at noon or night. During batch freezing, which requires the greatest number of horsepower but takes only six to eight hours weekly, all secondary operations are suspended.

If tools are scattered all over the map, it is a fairly safe bet that the mechanic is sloppy and does sloppy work. Tools are neatly hung on a wall board in the truck repair shop of a Newark, N. J., concern.

A Buffalo sporting goods manufacturer has speeded up the job of trademarking tennis balls since installing an electrically heated stenciling machine.

Trucks Can Cross Here

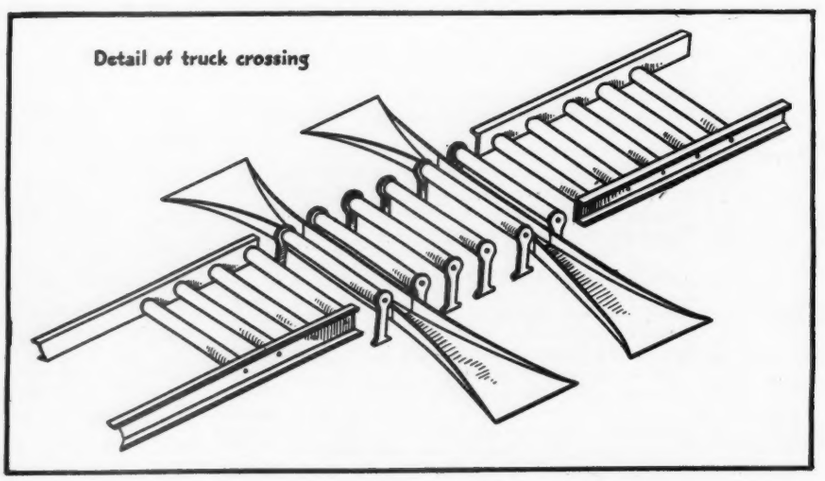
K. B. KEEFER
MacDonald Bros., Inc., Boston, Mass.

In the design of factory handling methods, it is frequently necessary to provide facilities for trucks to cross a line of roller conveyor. Two solutions are common—either a portable section in the conveyor, which can be removed to allow passage, or an arrangement of ramps and a bridge at sufficient height over the conveyor to provide clearance for the articles handled.

Neither method is ideal. Both methods are wasteful of time and effort. Then, too, with certain kinds of articles the ramp-bridge method is impossible because of the headroom required.

The attached sketch illustrates a third solution which has recently been recommended in the plant of a client and has proved thoroughly practical and satisfactory in everyday operation.

The conveyor side rails are broken for a sufficient distance to allow passage of the trucks. In this space the rollers are supported by pedestals fastened to the floor. To provide sufficient width for the truck wheels or casters, it may be necessary to space the pedestal rollers slightly wider than the regular roll spacing. Double "funnel" sheet steel ramps are permanently located, (1) to guide the wheels into the channels, (2) to provide sufficient elevation so that the truck underbody will clear the tops of the pedestal rollers.

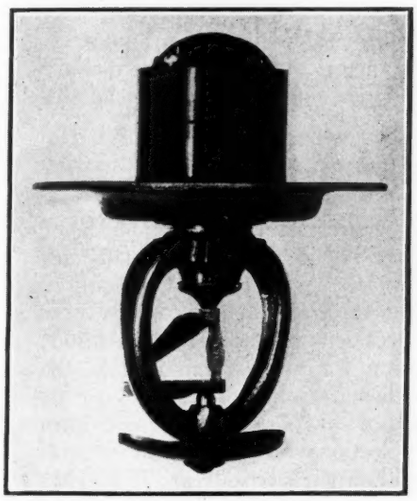


Mr. Keefer's contribution has been awarded the $10 payment offered by the editors for the best Management Short submitted during the past month.

• PRINTER, intended primarily to reproduce pencil tracings on tracing cloth, will reproduce "same size" any onesided copy that is semi-translucent.

• INCREASING popularity of indirect lighting in the residential field means

▼ ▼



Where water would raise hob with product or process, a solder-type sprinkler head sounds a loud warning instead of pouring water on the blaze

▼

new market for portable fixtures using that new three-light lamp with the 100-watt and 200-watt filaments.

• SIX NEW GRADES of cemented carbide supplement six existing grades, provide improved performance in special fields of application.

• "BARREL-SHELL" is what they are calling a new type of concrete roof. With it roofs of long span can be constructed without obstructing columns or trusses.

• NON-MAGNETIC and non-sparking tools of wrought beryllium copper are almost as durable as steel tools of similar design and size. Used for production and maintenance work wherever there's danger of explosion or fire.

• TIMBER CONNECTORS, which make joints two or three times stronger than bolts alone, were used to build a new 120-ft. tower upon which WEBC's old 230-ft. steel structure now sits.

• HOW manganese steel may be successfully welded, is described in a reprint now available.

• HIGH-PRESSURE mercury lamps —new and not like the mercury vapor lamps we all know—give the nearest thing yet to daylight when operated in conjunction with tungsten filament lamps.

• ROOM COOLER, just out, serves up to 600 square feet of floor space, conditions indoor air without too radical a change from outdoor conditions, delivers it horizontally in all directions.

• RUST-PROOFING, in the experience of a manufacturer whose specialty is casters for conveying equipment, is one of his most potent selling points.

• READY-FOR-USE cement of a casein-latex base is said to combine permanently any two materials, provided one of them is porous enough to absorb the moisture in the cement film. Manufacturer has enough faith in it to offer quart samples free.

• ALUMINUM "BOMBS," suspended from the ceiling, release a chemical fog that smothers incipient fires. No piping, no servicing, no upkeep.

• PORCELAIN ENAMEL is finding new decorative uses. Late examples are enameled coffee tables and cocktail trays.

• TAMPER-PROOF aluminum screw cap has on its lower edge a ring that's locked on the bottle and joined to the cap by tiny bridges. A twist breaks bridges, removes cap.

▼ ▼

For oil-, grease,- drip-, and odor-less lubrication, there is the rubber air gun which distributes as much powdered graphite as you want just where you want it

▼

You want to know

. . . . and the editors will be glad to tell you . . . . more about the things mentioned on this page

• SCREWS with slots like the above diagram require a special driver, but there's no danger of stripping.

• INDICATING fuse plug has an insulated disk underneath the link. Disk reads "o.k." until a blowout blots out the letters. Disks are in different colors to show different amperage.

• WHAT, NO BATHTUBS in TVA houses? The answer is, aluminum shower stalls are cheaper.

• FOR USE in company training programs, there's a new unit course of instruction in machine shop technology.

• WINDOWS in one of the newer air-conditioned houses close, occupants go on sleeping, when raindrops fall upon a sensitive recorder located on each sill.

• SAFETY NUTS, now on the market, have a spring locking ring of triangular section, same dimension as the thread, and a closing cap. The spring is coiled so that it offers little resistance when the nut is screwed on the bolt, but plenty in unscrewing.

• PUTTY that's combined with rubber contains practically no oil, needs no mixing, effectively resists corrosive chemicals and fumes, offers high resistance to moisture, sticks to steel surfaces.

• HOURS OF WORK—is their strict limitation a necessary measure in lessening the burden of relief, or is it a restraint upon the increasing momentum of business enterprise? A recently issued report presents a summary of fact and opinion.

(Continued on advertising page 76)

Factory Management *and* Maintenance

A consolidation of *Factory and Industrial Management* and *Maintenance Engineering*

L. C. MORROW, Editor

JULY, 1934

•

Wagner Bill Out

CONGRESS has adjourned without passing the National Industrial Adjustment Act. This bill, a substitute for the Labor Disputes Act, or original Wagner bill, was more temperate than its predecessor. Yet it contained so many of the objectionable features of the original that its passage could only have intensified the existing chaotic condition of labor relations.

•

Compromise Resolution In

CONSIDERED from the viewpoint of relativity the new Labor Disputes Resolution adopted by Congress shortly before adjournment should be acceptable to both employers and workers.

Obviously some kind of labor legislation had to be passed. Labor was in a continuing state of 7(a) hysteria. The big-stick powers of the Wagner bill were about to be nullified by Congressional adjournment. Apparently the President himself was not convinced that the country is ready for permanent legislation so drastic as that provided by the Wagner bill. A strike by steel workers was imminent. Hearing of the Weirton case had been postponed until September, leaving the authority of the Labor Board in question. With this background it was not to be expected that the administration would permit itself to be without an effective weapon of control during the summer and fall months.

One of the principal virtues of the compromise resolution is its temporary character. The Recovery Act itself is temporary. Since the Recovery Act as a whole is on trial, all of its parts are on trial. The most controversial part is its labor section. It is unsafe, therefore, to enact legislation to establish as permanent something that is unstable.

Briefly, the compromise resolution empowers the President to appoint a board or boards to investigate controversies arising under 7(a); empowers the boards to conduct elections to determine representation of employees, and to prescribe all rules and regulations in doing so; sets up penalties for violations of the rules and regulations so created; and limits the life of the resolution and boards to June 16, 1935.

Broad powers are thus conferred upon small groups of men. If the right men are selected, they will establish and maintain at least a temporary industrial peace. In their work they will compile case histories that will be invaluable as data on which to base permanent labor legislation when, as, and if that is done. We need case histories; we need more analysis of experiences in collective bargaining; in a word, we need more education in industrial relations. Industrial history is so long in the making that we can afford to guard against being precipitate.

•

Toward Arbitration

ATTEMPTS to secure lasting harmonious labor relations appear to be tending gradually toward acceptance of the principle of arbitration. William Green's plan for an impartial board of three appointed by the President points in that direction; so does the provision for boards contained in the recent compromise labor resolution.

The board proposed by Mr. Green would have authority to hold elections of spokesmen for collective bargaining. If such elections are held, they should show whether or not the membership claims of the Amalgamated Association of Iron, Steel, and Tin Workers are justified. They should also show the strength of the employee representation group.

Much has been heard from the delegated representatives of the union, much from the "rank and file" group. Both go about their business as though they represent all the steel workers. Yet the employee-representation group has not been inarticulate. It has claimed greater membership than that of the union, and in certain important plants has shown by ballot that the majority of the steel workers do not want a strike.

It is only just under any circumstances that the so-called "company union" group be heard. What are the facts?

•

Labor Landmark?

THE SINCLAIR agreement, treated in detail elsewhere in this issue, may prove to be a landmark in labor relations. It conforms more closely to 7(a) than any other agreement we have seen.

At the end of its year of effectiveness it should show whether or not union men are willing to pay dues while non-union men pay none for the same privileges and restrictions.

Certainly the union will try to increase its membership. Certainly the company, having reached an agreement with the union, and being protected to the extent of its membership against strikes, can have no interest in attempting to interfere with membership activities. Here, then, is a test case for observation. It merits suspended judgment.

Vital Document

ANYONE making an honest attempt to follow through on analyses of causes of economic ills and proposed remedies must study the recent Report on National Recovery and Employment of the Durable Goods Industries Committee, submitted to the President.

No comprehensive summary of this 97-page report can be given in the space available here—in fact, a satisfactory summary is difficult under any conditions because the report as a whole is a concise statement of the case for the durable goods industries followed by equally concise proposals looking toward revitalization of those industries with consequent great reduction in unemployment.

It is our opinion that the proposals constitute a program which, if carried out, would restore employment in large measure, with accompanying reduction in the burden of relief, and would aid greatly in the consummation of the social as well as the recovery aims toward which the administration efforts are being directed. We earnestly recommend a careful study of the report.

•

Piecework Precedent

PIECEWORK employees must get the minimum wage or its equivalent for all time spent on the premises of the employer, whether working or waiting for work, according to a ruling of the NRA in the case of 25,000 employees in the knitted outerwear industry. Some 8,000,000 workers in the country are paid by piecework, and presumably will come under this ruling if the issue is raised and is not covered in the industry codes.

Here is a precedent-setting decision, which places the responsibility for production planning squarely on the shoulders of management, where it belongs.

•

Recovery Evolution

NRA HAS laid down basic principles of price and cost regulation. They are applicable to future codes only, but are to be written into existing codes when and if the code authorities and the industries affected accept them.

This move recognizes that a recovery involving a hundred and one pricing methods is impracticable. The new regulation indicates willingness to change or eliminate the unworkable features of the recovery program. The same spirit was revealed in withdrawal of the service codes, and revision of regulations to permit blue eagle display upon conformance without signature.

These several developments are heartening. They take a long step toward simplification of industry regulation, point toward eventual retention of compulsory maximum hours, minimum wages, standards of practice, and abandonment of visionary, impracticable features of the recovery program.

They Think & Say

President Roosevelt

SECURITY • Next winter we may well undertake the great task of furthering the security of the citizen and his family. . .

These three great objectives—the security of the home, the security of livelihood, and the security of social insurance—are, it seems to me, a minimum of the promise that we can offer to the American people. They constitute a right which belongs to every individual and every family willing to work. They are the essential fulfillment of measures already taken toward relief, recovery, and reconstruction.

Hugh S. Johnson

JOBS • When men talk about a minimum wage of $1 an hour for a 30-hour week in the steel industry, they are advocating indirectly a great increase in the cost and price of steel—but with more than 8,000,000 workers out of employment, and agriculture prostrate, a sizable vertical mark-up in the price of steel would curtail production in that and nearly every other great industry in the country. It would give us a new wave of unemployment and perhaps ruin the whole recovery movement. . .

It is for this reason that it is cruelly unfair for leaders to promise men through strikes and violence to get for them in particular little areas of the industrial field, extravagant and impractical wages. If they could make good their promise on wages, they would more than offset them by reduced employment for the very men to whom they make the promise of high wages. What this country needs is production and jobs—jobs—jobs.

J. E. Winter
President, The Winter Brothers Co., Wrentham, Mass.

CHISELING • You (Governor Wilson of Vermont in June, advertising page 46) have referred to large manufacturers from outside your state underselling your smaller local firms. I have before me evidence of one of your smaller manufacturers disturbing a whole industry. In one manufacturing line with which I am in contact there are at present only three or four real price-cutters. They are the smaller members of the industry. They pay low wages; cater to all the lower grade of cut-price distributors; and disturb the better grade of buyers.

Are you perfectly familiar with all the conditions that have led small Vermont manufacturers to complain? I have found the inefficient price-, quality-, and pay-cutters are always complaining about the higher-grade firms, trying to excuse their own inefficiency.

William J. Graham
Vice-President, Equitable Life Assurance Society of the United States

GOAL • In the management field today we are harassed with the particular problems of the operation of our various activities under conditions which have been extraordinarily unfavorable and which at the minute are more favorable in their promise than in their actuality. None the less it is at such moments as these and through such dark days as we have experienced within the last four years that vision is necessary and

that an objective, however idealistic, can well serve to focus our attentions upon the ultimately desirable so that, while we walk in the paths of immediate necessity, we will have the stimulated assurance that we are walking in the direction of high ambitions. Again restated, this ambition must be a full order of productivity distributed among a people where willing workers are employed to the full of necessity to produce abundantly and on an ever-increasing scale of living, and that this living include the use of time for both work and for organized leisure if we are to live life to the full. It is a matter of management.

The St. Louis Post-Dispatch

ARBITRATION • While industry remains fearful of compulsion in labor disputes by way of the Wagner bill, one strike settlement after another proves arbitration, the best of all means, perfectly practicable.

The thing can be done. It is being done. There is steady improvement in employment, and wages are going up.

This is the right way to settle disputes between capital and labor. It leaves both perfectly free. It is the democratic way.

Why, then, should the Wagner bill in any form continue to make the country apprehensive that compulsion is to be used in a field where freedom is so increasingly successful?

Agreement is possible when both labor and capital are quite free to bargain, and the record proves it.

F. A. Lorenz
Vice-President, American Steel Foundries, Chicago

REGULATION • If Government is going to regulate and reform business under the so-called emergency legislation, it should regulate all phases of industry, including labor and labor organizations. Capital and management are already regulated—why not labor?

O. D. Reich
Vice-President, Dexter Folder Company, New York

NO CHOICE • The manufacturer who has relied on long hours, on low rates of pay, or on uneconomical competitive practices now finds these business advantages taken away from him by law. The longer the hours which he has been accustomed to work, the lower his former rates of pay, and the more inefficient and wasteful his previous methods, the more critical is his present situation, the more radical the required change in his mental attitude, and the more far-reaching the improvements which he must set himself to make. The codes fix his hours of operation and his minimum rates of pay—but they do not prescribe the output which he should obtain from each minute worked whether by man or machine, nor do they inhibit his ingenuity and resourcefulness in the adoption of more efficient machinery and methods in place of those which he now has. The easy offset to inefficiency is gone. No longer is the adoption of modern management a matter of choice; it has become a question of life and death.

—good thing that match wouldn't burn

James W. Hook
President
Geometric Tool Co.
New Haven, Conn.

LOWER PRICES • If it were only possible to convince people that increased consumption will be stimulated by lower instead of higher prices and that lower prices will only result from decreased costs, then perhaps these needed durable goods would begin to move and employment in the industries producing them start to increase. But if anyone believes that the movement of these goods will follow increased costs or the shifting of purchasing power from one to another, he is, in my judgment, headed for a rude awakening.

C. S. Craigmile
General Superintendent
Belden Manufacturing Company, Chicago

UNDERSTANDING • Frequently frank discussions about the facts of operations may very well dispel the antagonism which sometimes develops between employee and employer through the lack of understanding of each other's problems. If we believe that some of the information and advice which employees get from outside sources may be inaccurate, untrue, or even viciously harmful, it is certainly the responsibility of management to see that the correct information and facts are made available to them.

In this connection particular attention should be paid to instructing all supervisors in sound economic principles, in the important issues of the day, and in the facts of operation of their own particular business. In other words, our supervisors should be fully equipped to represent management in their dealings with employees, remembering that with a great many individual employees most of the management contact they have is with their immediate supervisor.

[The last four quotations are from addresses made before the General Management Conference of the American Management Association.—Ed.]

Cooling Large Inclosed Motors

J. V. Hunt

Industrial Motor Department
Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

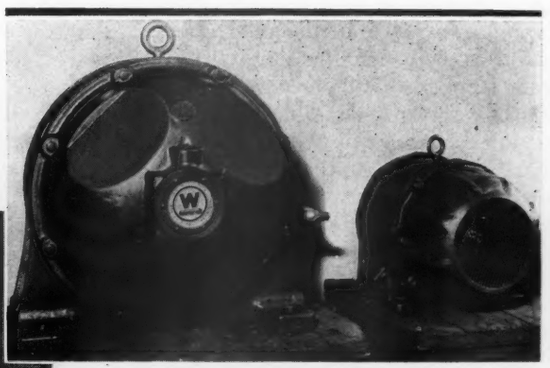


Figure 1. Of equal rating, but the one at the right is ventilated and the other isn't

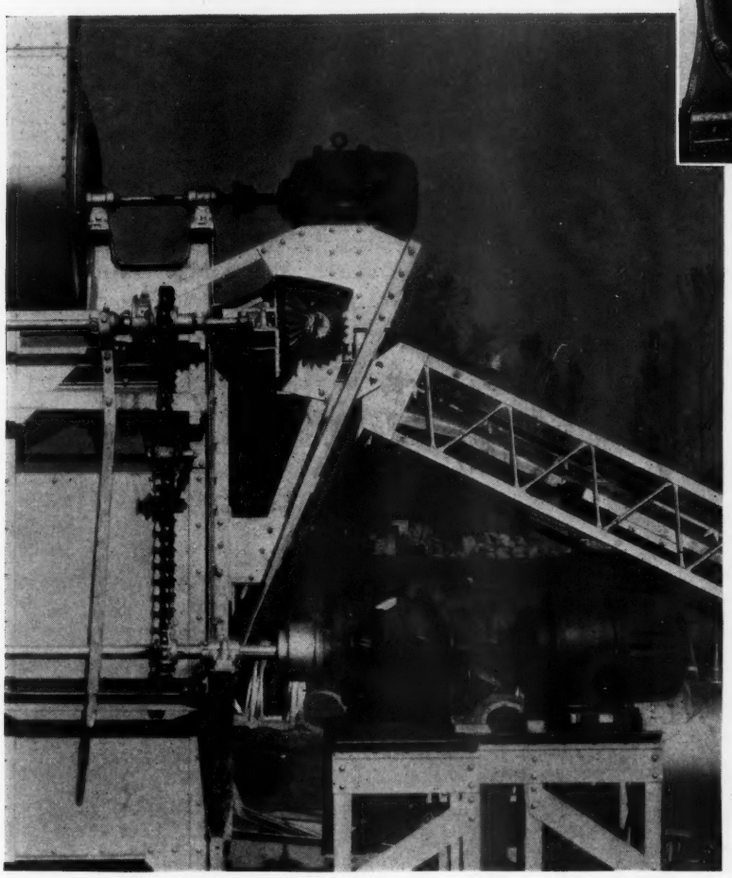


Figure 2. Totally inclosed, fan-cooled, these 20-hp. motors keep themselves cool and are not affected by dust or weather

NON-VENTILATED construction is commonly used for totally inclosed motors as large as 3- to 5-hp. rating, since the heat generated in the windings of these small machines is quickly radiated from the surface of the motor. However, the greater the power delivered by a motor, the larger the amount of heat generated by its windings, and since the surface area of a motor varies as the square of its physical dimensions, whereas its volume varies as the cube of these dimensions, it obviously becomes more difficult to cool inclosed motors as the rating increases.

Experience has shown, nevertheless, that self-ventilation assists in cooling and at the same time reduces the size and cost of inclosed motors. For example, a totally inclosed, non-ventilated motor of 25-hp., 1,160-r.p.m. rating is about 35 inches in diameter and weighs approximately 3,000 pounds, whereas a motor of similar rating of the self-ventilating, fan-cooled, totally inclosed type is only about 20 inches in diameter and weighs less than 600 pounds. Figure 1 illustrates the comparative size of these two types of motors, same horsepower and speed. It is evident that the self-ventilated motor is less expensive to build.

Fan-Cooled Motors

It is not surprising that the trend is now towards the self-ventilated type of motor and away from the pipe-ventilated, or forced-ventilated, type since the latter is more difficult to install and maintain.

Some of the early designs of fan-cooled motors made

use of copper shields which were shaped to form a seal around the windings. In some cases copper fins are welded to the outside of the primary core to increase the radiating surface of the motor. An external fan driving air against these surfaces keeps the motor cool. Figure 2 shows a couple of 20-hp., totally inclosed, fan-cooled motors of late design operating an asphalt plant.

These motors are equipped with an external ventilating fan mounted on the motor shaft, which draws air in one end of the motor and drives it out the other end. The ventilating air may be laden with dust or rain, but it can do no damage since it cannot come in contact with the windings. This single-end-ventilated type of construction is now commonly used for inclosed motors ranging from 5 to 50 horsepower.

Figure 3 shows a 200-hp., totally inclosed, self-ventilated, fan-cooled motor which has practically the same physical dimensions as the 25-hp., non-ventilated totally inclosed motor shown in Figure 1. That the method of ventilation must be effective is evident when it is considered that the losses in a motor of this size amount to about 14 kilowatts, or about seven times as much as for a 25-hp. motor. The electrical energy in 14 kilowatts is sufficient to heat a small, well-ventilated house comfortably in zero weather.

In Figure 4 is shown the type of construction known as "dual ventilation," which is used for the larger fan-cooled motors. The heated air within the motor is circulated through ducts that lie adjacent to ducts carrying cold air. In other words, this construction gives a heat exchanger effect. A single fan on the rotor keeps the air in constant circulation within the motor, while two external fans mounted on the shaft at the ends of the motor drive the outside cooling air at high velocity through the external air ducts from which it is exhausted at the center of the motor frame. Double-end ventilation is required to cool these large motors.

Explosion-Resisting Motors

There are some applications, such as those encountered around oil refineries, where it is not only desirable to protect the working parts of the motor from destructive agencies, but also to give protection from explosive gases or liquids. The explosion-resisting type of fan-cooled motor is assembled with accurately machined surfaces and close clearances.

The entire construction is such that flame cannot escape to the outside, even in the event of an explosion within the motor. Motors of this type are used in chemical plants where hazardous materials are manufactured, alcohol plants, rayon plants, dry cleaning plants, refineries, and the like.

Experience has shown that the savings resulting from fewer motor repairs and less interruption to production more than justify the higher first cost of motors which are adequately protected for the service conditions.

▼ ▼ ▼

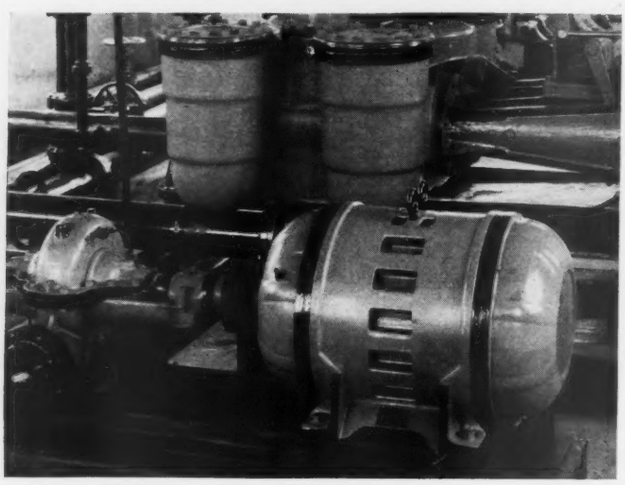


Figure 3. Rated 200 horsepower, but hardly looks it. An effective system of ventilating makes it possible to build a powerful motor within a comparatively small frame

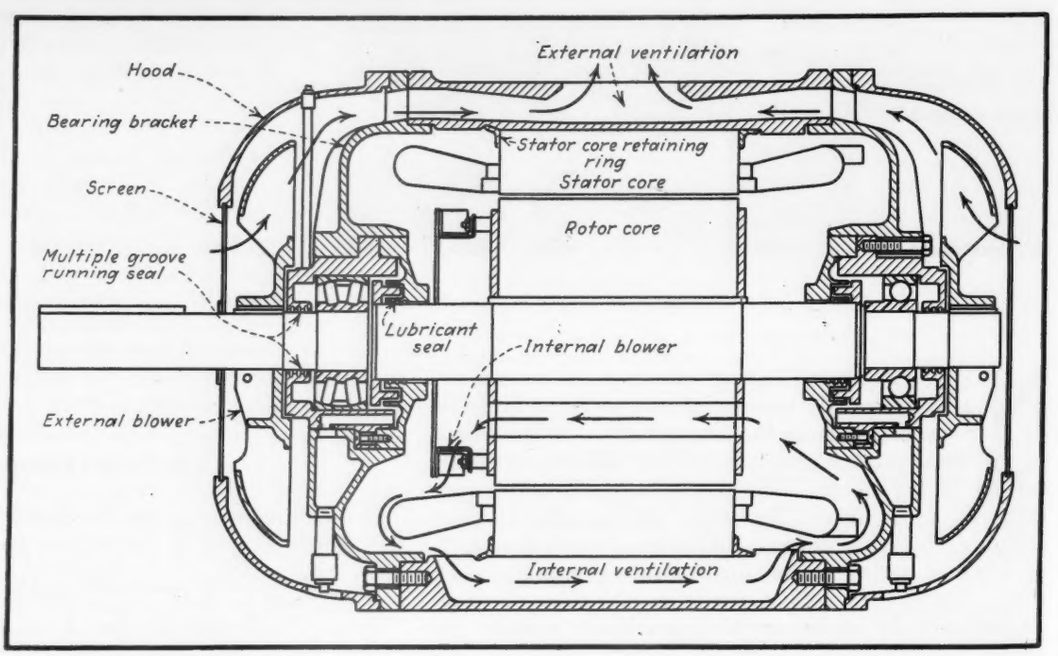


Figure 4. How the motor in Figure 3 is cooled. Upper arrows show the path of the external cooling air. Direction of circulation of air within the motor is shown by the lower arrows

May Cost Little to Save Much on Power Transmission

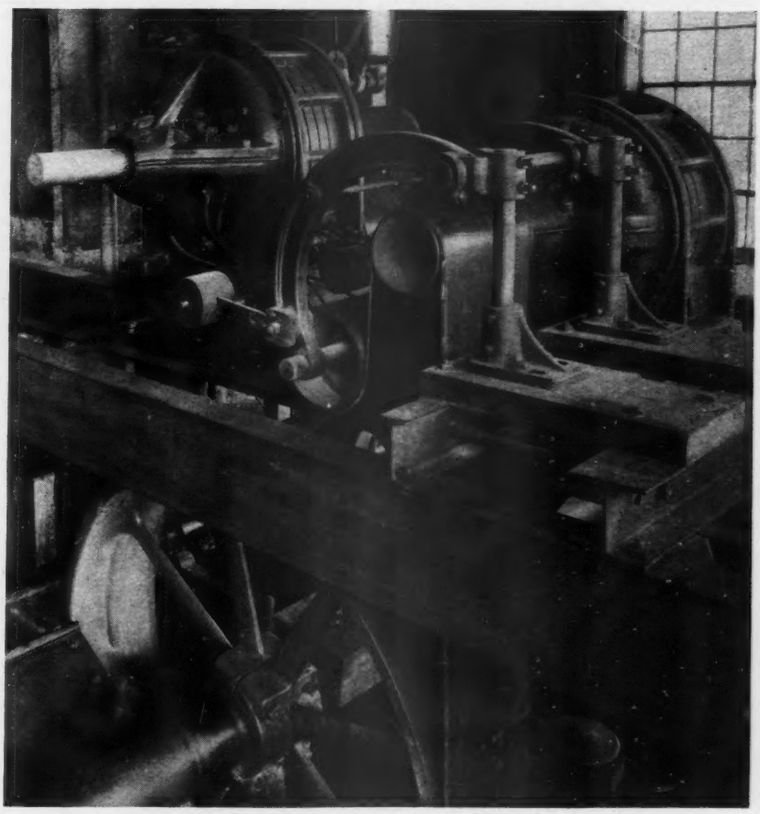
Easier to find a hundred *chances to save $10 than* one *chance to save $1,000*

Robert W. Drake
Mechanical and Electrical Engineer
De Kalb, Ill.

MANY PLANTS that were built or completely modernized since the War are seeking to make detail improvements that will show an attractive saving on a moderate investment. Tool and jig equipment, changes in design of product, improved manufacturing methods—all have been subjected to microscopic analysis. In many cases, however, the distribution of power to the driven machine has received comparatively little attention.

It is an exceptional plant that does not contain a surprising number of opportunities for worth-while improvements in mechanical transmission details, opportunities for improved application of electric power, and so on. More often than is realized, savings can be accomplished with little or no expenditure beyond the cost of investigation necessary to locate the leaks.

Again and again I have heard men say: "Our total power expense is only 2 per cent of our annual operating expense. Why spend a lot of time and trouble investigating such an item? If we could cut the total 10 per cent, we would hardly notice the difference."



An impossible drive becomes possible, with the help of an idler

Such a statement shows a fundamental misunderstanding of how such improvements work out. In many cases the principal savings from improvements in the application of power appear in reduced losses from delays to manufacturing, less scrap, fewer rejects, and increased output per man.

The first step in locating these opportunities for improvement may well be to accumulate a list of all items within the departments under investigation that require unduly frequent or costly repairs. It is easy to list a few sore spots, but difficult to build up anything approaching a complete list. The principal difficulty is the fact that many, probably most, of the troubles with items that require frequent or constant maintenance impress the men who are in daily contact with them as annoying but practically unavoidable.

If such a list is started at an informal discussion attended by the millwright, electrical, and other service department foremen and their assistants, with the master mechanic or plant engineer, a few pet sore spots will quickly be brought out; then matters will drag.

When certain troubles are mentioned, it will imme-

diately be evident that the consensus is: "You can't do anything about that."

It is possible to break through such convictions. A few object lessons should be selected with great care. They should be cases where ingenuity and a very moderate expenditure can cure a long-standing difficulty and benefit both production and maintenance departments.

For example, on a troublesome vertical drive install a belt of ample size to carry the peak loads, not the average load, with a gravity-operated idler pulley of generous diameter to maintain the necessary tension. If the drive is vertically downward from an overhead motor, install an overhead-type, pivoted motor base.

The right kind of young man assigned to this task can work through and with the foremen and hold informal meetings with a few selected maintenance mechanics. This will set more men to thinking.

In the few plants where every repair on an individual machine or motor is recorded, together with the cost, a critical study of such data will be helpful. In one instance it led to the discovery that six identical machines each had an annual repair cost in excess of the initial cost. Investigation showed that many of these breakdowns delayed 150 men from one to three hours each and caused a considerable number of them to be held overtime on many occasions to pour off hot metal. Changes that were immediately made, reduced these delays more than 90 per cent.

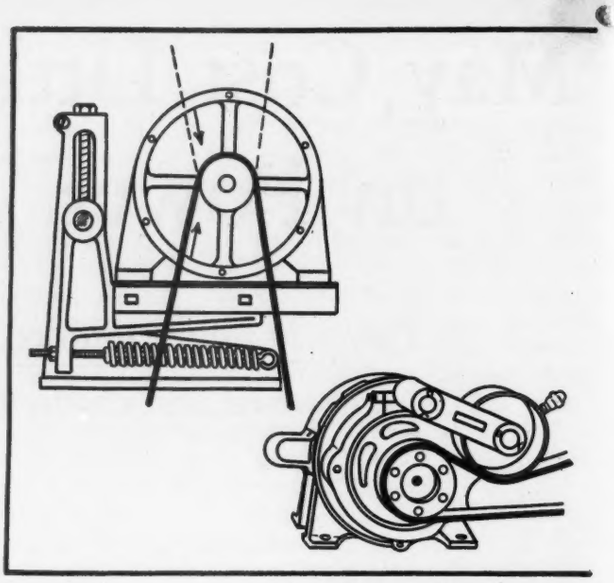
$1 Bearings Save $1,665 a Year

The man who checks motor overload complaints may know of machines that develop recurrent troubles which cause gross overloads on the driving motors. While running tests in a cotton mill one maintenance man found that the installation of a ball thrust bearing costing $1 would save $\frac{1}{12}$ horsepower on each of 450 identical machines in one room. The power saving alone was $1,665 a year, aside from other incidental advantages.

It is often worth while to maintain a log for six months or a year in each department that carries on maintenance work. Every maintenance job, big or little, should be recorded. At a round table held each week a rough estimate of labor and material cost and the frequency of recurrence may be entered opposite each item. Such a list will produce many suggestions. After a year or less of such procedure it may no longer be profitable. Most of the items worthy of study, or many items of the same general type, will come up for discussion within the first six months. All maintenance foremen and many production foremen will become "improvement minded." It will no longer seem proper to make the same detail repair or replacement again and again without considering the possibility of removing the cause.

When a considerable number of possibilities have been listed, rough estimates covering frequency and cost of maintenance, adjustments or repairs, and the frequency and cost of delays should be prepared. They will make it possible to select the most promising items for attack.

In a previous article it was stated that it almost invariably pays to use anti-friction bearings in groupshaft hangers on new work. The increased cost of this type of bearing, including installation, is not great. In rehabilitation work the replacement of existing babbitt-lined



Two good ways to keep proper belt drives—by using a pivoted motor

bearings with ball or roller bearings may or may not yield a sufficiently attractive return to earn a place on the list of improvements to be made.

In almost every case, however, it will pay to install ball bearings in all countershaft loose pulleys. Maintenance of such pulleys with sleeve bearings is surprisingly troublesome and expensive. In most plants it will also be found worth while to install ball bearings in countershaft hangers. The installation cost is small, since no pulleys or couplings need be removed. In most cases it will pay to install ball bearings in groupshaft hangers at the points of heaviest pull-off—for example, in the hangers nearest the motor drive pulley.

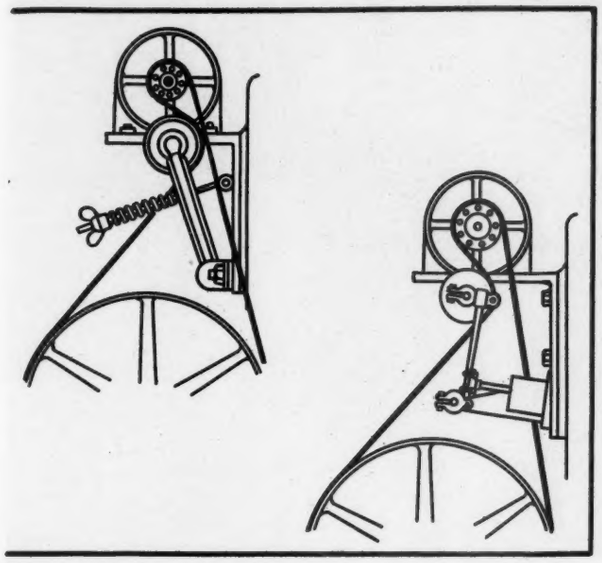
Ball or Roller vs. Sleeve Bearings

Data on which to base an estimate of the power saving possible through the substitution of ball or roller bearings for sleeve bearings were given in the October, November, and December, 1931, issues of *Maintenance Engineering*. In most applications the power saving, although important, will not be the sole determining factor. Either ball or roller bearings will save three-fourths of the labor and material cost of lubrication, as compared with ring-oiled, babbitt bearings.

Anti-friction bearings are obtainable in mountings which will fit existing hangers. All may be obtained in mountings that will eliminate drip of lubricant. Spiral rollers may be obtained with the races split and thus may be installed on shafting in place.

To install balls or taper rollers on existing shafting requires the removal of all couplings and at least one-half of all pulleys.

When the list of recurrent troubles includes motors that have failed repeatedly, it is unwise to conclude that overloading is the probable cause. If the hand can be held on the motor laminations for five seconds after the motor has been operating under its heaviest duty for some hours, overloading as a cause of failure can be ruled out. If bearing failure is the cause of winding failure, it will be evident. Less evident are failures



tension in horizontal and vertical base, at the left, or an idler

from conducting material in the air, such as cast-iron dust. The most effective treatment is dipping and baking complete stators or armatures. Stators should be dipped hot. Two or three dips in a high-grade, oil-proof varnish are necessary for complete treatment.

In the list of expensive nuisances there will almost certainly be a number of belt drives, particularly short-center and vertical drives. Too many belt drives are "designed" by guess. Many others are proportioned for the average or nominal load with little consideration for peaks. Almost all motors of 5-hp. rating and less exert 3 to 3½ times full-load belt pull before they reach full speed; a few single-phase motors reach four or even five times normal belt pull in coming up to speed.

The practical limit to the capacity of belting is not the load which it will carry long enough to run off a laboratory test. It is the load which the belt will carry without stretching rapidly enough to require unduly frequent take-up. If a belt needs taking up every few weeks, it is next to certain that this attention will not be given. The result is slip, power loss, decreased production, often poor quality of product due to under-speed.

Wider Belts or Larger Pulleys

The first step in correcting a troublesome belt application—V-belts as well as flat—is to make sure that the belt is ample in width and not too thick, considering the diameter of the smallest pulley of the drive and the belt speed. Where the belt is overloaded and it is impossible to install a wider one, or where the bearings of either driver or driven machine cannot stand increased belt loads, the expedient most generally applicable is to increase the capacity of the widest belt that can be fitted into the available space by increasing the speed of travel. In other words, increase the diameter of both driving and driven pulleys. In this way drive capacity can be increased without increasing belt width or bearing loads.

Increase in diameter of the smaller pulley often permits the use of thicker belting or the next larger size of V-ropes, and thus further increases drive capacity.

There is little to be gained by increasing belt speed above 4,200 feet per minute for flat belts or 3,500 for V-belts. Further increase in capacity with increased speed is almost completely nullified by the effects of centrifugal force, while belt life and drive losses are affected unfavorably.

When it is not possible to increase the pulley diameters, or the belt speed is already close to the limits mentioned above, several other helpful expedients are available. In many cases several of these must be employed. Together they may be sufficient to correct a very troublesome application.

The substitution of paper pulleys for the metal or wood type will decrease belt slippage materially, frequently 40 to 50 per cent. Roughly, this expedient will increase the drive capacity 15 to 25 per cent, depending upon the material of the old pulleys. If one of the pulleys of the drive is several times as large as the other, it will be necessary to replace only the smaller one.

Use of a special tannage belt in place of the more usual oak-tanned leather has a similar effect and increases the capacity of the drive about 10 per cent without increasing the total tension in the tight strand.

With either or both of these expedients the slip will be decreased so much as to give a false impression that the trouble is cured. Actually, in drives that are grossly overloaded even after such reduction in belt tension as these two expedients provide, the belt slippage may not be noticeable for a time, but the rate of stretch may still be so great that take-ups are necessary at unsatisfactorily short intervals. The solution is a longer or wider belt, provision for automatic take-up, or both.

Tension

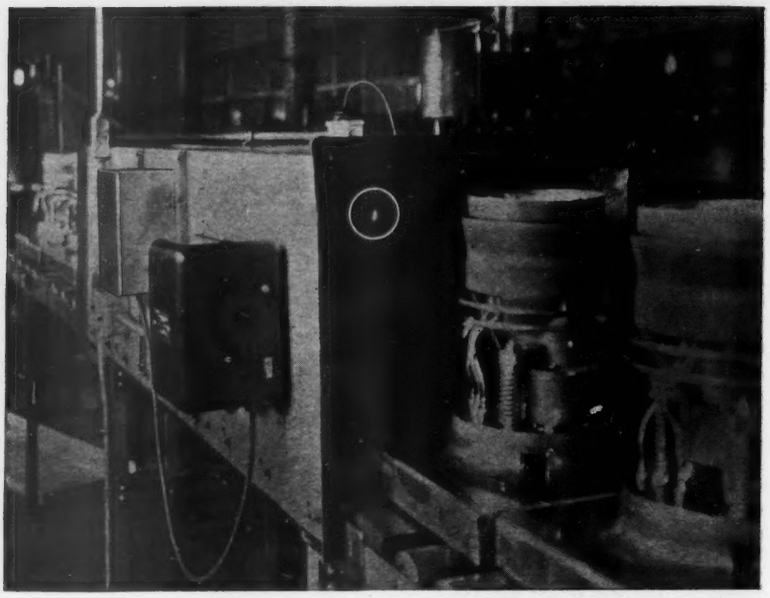
Certain types of belt drives are likely to be troublesome, even when well designed, unless mechanical means are provided to maintain continuously the tension necessary for transmitting the required power. This is usually accomplished by means of the pivoted motor base or the gravity idler. The former is applicable only to belt drives from motors or unusual special applications where some variation in center distance may be provided for, such as a forge blower driven from a groupshaft. Pivoted bases are applicable to flat-belt and V-belt drives.

An idler may be applied to almost any flat belt drive, whether the center distance is fixed or variable, but in general it is not applicable to V-belt drives of more than one rope.

First among the applications where continuous mechanical tension adjustment is indicated, are drives on short centers, particularly those short-center drives in which one pulley is much larger than the other. Such drives may be operated satisfactorily without automatic tension adjustment only by frequent manual belt take-ups and good judgment.

Second in the list of applications where automatic mechanical tension adjustment is indicated, are the troublesome vertical belt drives. Vertical belt drives are particularly likely to be troublesome where there is considerable inequality in pulley diameters and the smaller pulley is below, or when the center distance is large. If vertical drives are to be operated without mechanically maintained tension, they should be very liberally belted.

R. F. Emerson
Industrial Engineering Department
General Electric Company
Schenectady, N. Y.



"Handling" Brings Up These Motor and Control Problems

Here are proper combinations of equipment that have been worked out to meet operating requirements

IN ONE plant it was necessary to unwind a band of frail material from a reel and carry it across a cutting table which is essentially a belt conveyor. In the arrangement that was eventually worked out the material is allowed to sag between an idler and the cutting table so as to cut light beams that are focused on two phototubes placed one above the other. When the loop of material becomes short enough to cut off the upper light beam, the corresponding phototube acts to close the circuit of a magnetic starter, which starts the reel motor.

Assuming that the loop becomes so long that it interrupts the lower beam of light, the lower phototube serves to open the starter and the motor stops. As the material gets used up, light is admitted again to the lower phototube, but the motor does not start until the loop cuts off the light to the upper tube.

Problems that are similar in principle came up in a wire drawing plant and in a rubber factory.

In the first it was required to maintain constant tension on a wire being wound onto a spool, and to slow down the speed of the winder gradually to compensate for the increase in the spool diameter.

In the rubber factory the rubber in the form of a long ribbon is carried considerable distances over a series of conveyors while passing through the various processes. It was necessary that the series of conveyors run at exactly the same speed.

Mercury-vapor-filled electron tubes were used in both instances to produce the desired results. Electron tubes of this type have the property of rectifying or changing an alternating current to direct current. The amount of direct current obtained from the tube can be varied by the position of the armature in a small solenoid, which can in turn be controlled by a pulley or roll riding on the material. Required variation in speed is obtained by field control, through the tubes, of the shunt-wound, direct-current driving motors.

One plant had to work out the problem of stopping and spotting large flasks, weighing several tons, with an accuracy of one-half inch. Limit switches were arranged to cut off power from the handling mechanism and slow up the travel until the flask is within several inches of

the desired stopping place. At this point the edge of the flask interrupts a beam of light focused on a phototube, which causes a solenoid brake to set. By this method the stopping point of each flask is controlled with an accuracy well within the desired limits.

In a plant that manufactures refrigerating machine units it was desired to have some means of keeping track of these units as they pass along the assembly line. A further requirement was that the count must be registered at a point some distance away from the assembly line.

The simplest way to meet these conditions was to install a phototube, Figure 1, with a light source so placed that the beam normally shines on the tube, but is interrupted as each refrigerating unit passes by on the conveyor. Through the medium of a simple relay, interruption of the light beam is made to operate a magnetically driven counter located on the foreman's desk.

Figure 1 (left). As each unit passes along the assembly line in front of it, a phototube housed in the white box at the left rings up one on a counter located some distance away

An industrial plant had three long conveyors that were operated in sequence, each driven by a squirrel-cage motor. Because of differences in load the motor speeds varied, with the result that material piled up at different places, interfering with the operation of the production line.

To eliminate this trouble a small, wound-rotor motor was connected to each driving motor, with the proper control equipment to form a Selsyn tie. Now the three driving motors are positively locked in step while operating, as well as during the starting and stopping periods.

Quality and a Speed Ratio

Quality of the product in another plant depends largely on maintaining a fixed ratio between the speed of a large motor driving a kiln with that of a small motor which is some distance away and drives a feeder. Use of power Selsyns did away with cumbersome mechanical connections between the two units and make it possible to maintain a definite speed relation between the two motors throughout the required speed range.

Figure 3. Keeping step with the demand, this brush-shifting alternating-current motor drives a pulverized coal conveyor

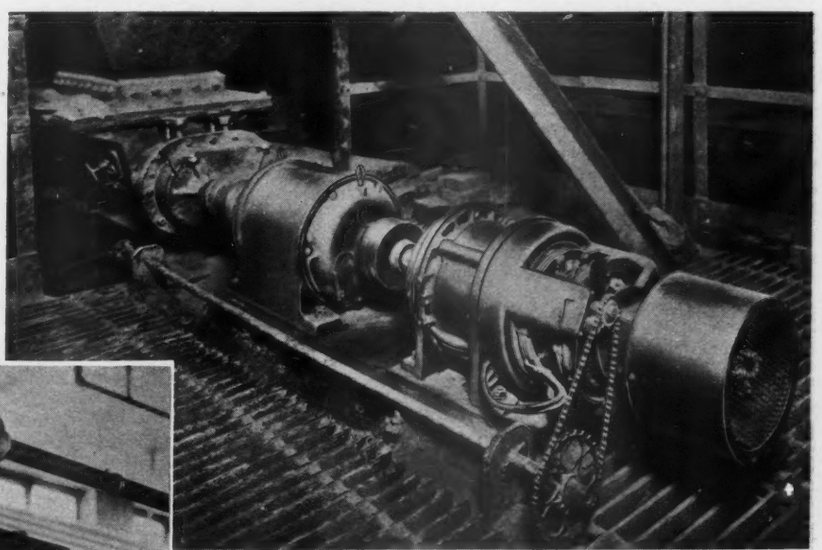
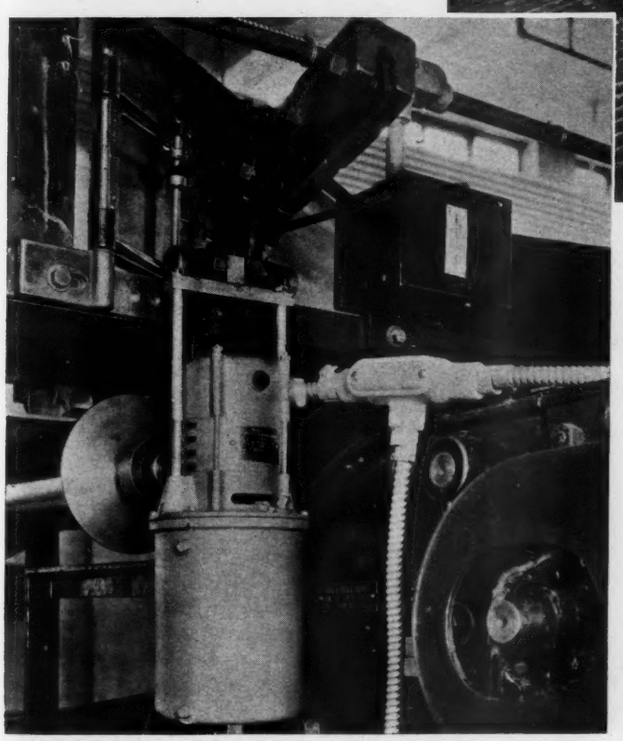


Figure 2. A Thrustor unit operates the gate of a cotton distributor in a textile mill



The problem of automatically deflecting boxes from a belt conveyor to any one of several gravity conveyors was solved by the use of so-called Thrustor units. These are devices for producing a straight-line thrust whose magnitude may be anywhere from 50 pounds to several thousand pounds (depending on the size) by means of a small motor. In the usual sizes a fractional horsepower motor is used.

Fourteen of these devices were installed, one being located at each gravity conveyor. Pins are located at certain places on the boxes, the location of each pin corresponding to a limit switch which actuates the Thrustor unit that will push the box off at the desired place. After the box reaches the gravity conveyor, it passes over another limit switch that releases the unit and

(Continued on advertising page 62)

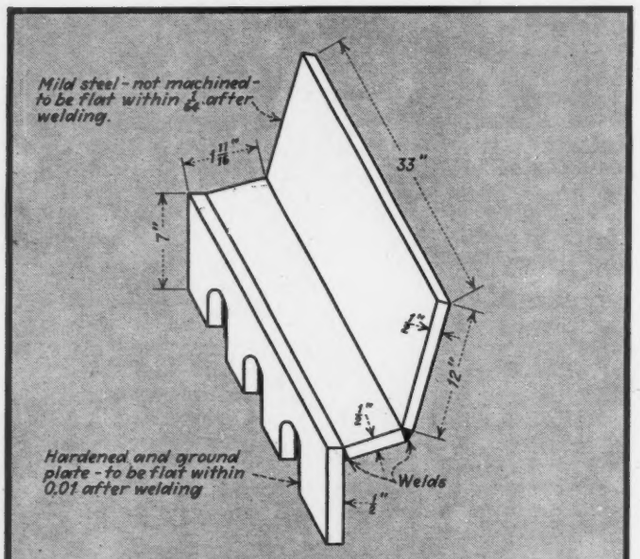


FIGURE 1 - What the Designer Wanted And Obtained

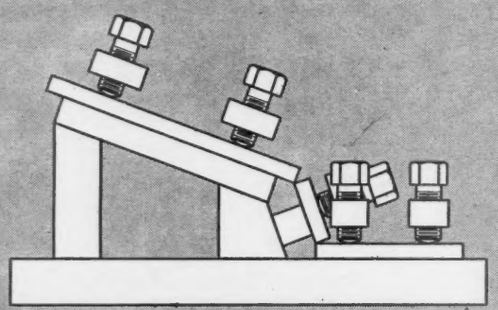


FIGURE 2 - How the Clamps Were Arranged (Same at both ends and center)

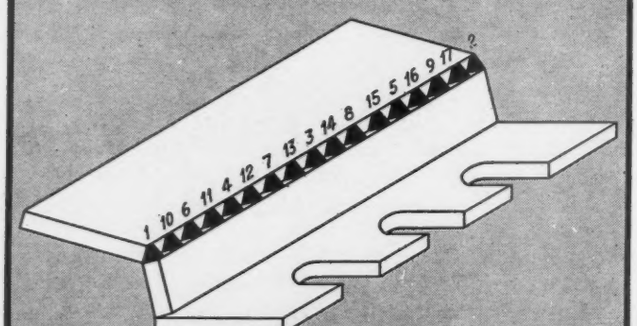


FIGURE 3 - Welding Sequence - 1" Long Welds

Welded Without Distortion

H. F. Kneen
Factory Manager
The Lincoln Electric Company, Cleveland

TO ASSEMBLE parts by welding, allowing excess metal, which will later be machined off, is to overlook one of the important economies of the welding process. In support of this statement, I show here a welding assembly that we made recently. In the distance between the two parts shown in Figure 1 a variation of only 0.01 inch was allowed.

This meant that there must be no distortion in the hardened steel plate *A*, which was welded to plate *B*, which was welded to plate *C*. The plates, finished to size before welding, were clamped in position, as shown in Figure 2. They were then tack welded at points 1, 2, 3, 4, 5 (see Figure 3) in that order. One-inch welds were then laid intermittently as indicated.

I draw from our experiences with this assembly and many others to make some positive statements concerning the prevention of distortion.

Distortion is not necessary if due care is taken. Welding may be employed satisfactorily in machine design where dimensions must be kept to $\frac{1}{64}$ inch. Moreover, 80 per cent of the machining should be done before the welding—not after. More often than not it can be eliminated entirely by welding ordinary structural shapes to finished dimension.

The due care of which I speak involves an analysis of the possible distortion that may be encountered, and in minimizing it. The amount of distortion caused by welding is dependent upon: (1) Mass and shape of parts; (2) method of clamping; (3) welding sequence; (4) current used; (5) welding speed.

It is important that the work begin with the designer, who should seriously study welding.

Factory management must recognize the fact that new shop processes demand new shop methods. The manufacturer who sings aloud of the economies to be effected by welding often neglects to use the very methods that make possible these economies, such as machining before welding. Is he using the best method of clamping and the proper sequence of welding? Are his operators using the proper current for the job? Are they getting the proper speed? He is above the average if he knows these things, and congratulations will be offered him in the form of profits. Distortion in welding is not a legitimate expense—it is an extravagance.

We're Always Looking for Trouble

Preventive maintenance catches defects when they're minor repair jobs and averts most of the major breakdowns

Theodore Clark

Staff Executive on Manufacturing
The Kendall Company, Boston

PREVENTIVE maintenance in the plants of The Kendall Company is essentially the systematic inspection at stated intervals of all parts of machinery or equipment which, according to experience records, have shown themselves most apt to give trouble. Repairs and replacements are based on the conditions revealed. Our plan is applied not only to productive machinery, but also to power transmission equipment.

The inspection work is done by a specially trained individual, usually a first-class machinist, and is confined to the physical condition of the equipment. The program does not include an inspection of the operating adjustments of the machinery, which is regarded as the function of the department foreman. Experience has shown us that foreman and operative alike welcome advice as to lowered efficiency or impending failure of equipment, provided the advice has to do with the mechanical condition and does not encroach on the operative's or on the foreman's prerogative as to the method of operating the machine.

To set up a plan of this kind, the first step must be a study of each type of machine, preferably made jointly by inspector, plant superintendent, and room foreman. An inspection form (Figure 1) is then prepared, setting forth carefully the parts to be inspected. For instance, "Are jack gears properly meshed?" If the answer is "No," the inspector must then indicate what course of action should be followed. In some instances the inspector can readjust the gear setting himself. In others this may be impracticable, either because of the nature of the adjustment

MACHINE INSPECTION

Tickle Date			
~~4/27~~			
5/7			

Machine :- *Finishing Mangles*

Inspection Classification :- *General*

Frequency :- *Daily*

Inspector :- *Machinist*

Check (✓) if in good condition ; mark (x) if in need of repairs which cannot be done during inspection , explain below.

Inpection Items	Condition No.1	Condition No.2
1. Scutcher	✓	✓
2. Foxwell Guiders	✓	✓
3. Rolls in Foxwell Guider stands	x	✓
4. Top and bottom immersion rolls in Wash Box	✓	✓
5. Squeeze rolls on Wash Box	✓	✓
6. Immersion rolls in Water Box at Mangle	✓	✓
7. Lubrication of Main Mangle Bearings	✓	✓
8. Plaiter rolls	✓	x
9. Plaiting mechanism	✓	✓
10. Drive of Mangle	✓	✓
11. Leakage around "Baffles"	✓	✓
12.		
13.		
14.		
15.		

Note below needed repairs :-

Item 3 :- Bottom roll No. 1 Mangle in bad condition., new bearings and new journals needed.

Item 8 :- Rubber covering on 2nd plaiter roll needs to be tightened.

Signed :- A. H. Murray 4/27/34

Figure 1. First step in the Kendall program of preventive maintenance is a study of each type of machine and the preparation of a form noting the vital points to be inspected. Upon this form the inspector makes his recommendations

TIME RECORD

NO.	TIME	HRS. WORKED	HRS. CHG'D
	Out		
	In		
	Out		
	In		
	Out		
	In		
	Out		
	In		
	Out		
	In		
	Out		
	In		
	Out		
	In		
	TOTAL TIME		

6F7AB Date 4/30/34

MACHINE REPAIR TICKET

WHEN WANTED	DATE	TIME	CHARGE OBWM
	5/5/34	4-0'clock	MACHINE #2 Fin. Mangle

Description of Work

Tighten the rubber covering on the 2nd platen roll.

Signed O. A. Elwin Foreman

I have completed the repair stated above.

Signed Repair man

Repair inspected and approved.

Signed Foreman

JOB NO.	ACT. TIME	EST. TIME	POSTED

6F 30 AB
L M CO.

REQUEST FOR EQUIPMENT

No. 269

DEPT. Bleachery

EQUIPMENT NEEDED Repair the bearings for and the journals of the bottom brass roll in the guider stand of No. 1 Finishing Mangle

PURPOSE OR ADVANTAGE

DATE WRITTEN 4/30 19 34 SIGNED O. A. Elwin
DATE WANTED 19 REQUESTING DEPT. HEAD

ESTIMATED COST $32.50 ESTIMATED DELIVERY
DATE 4/30 19 34 SIGNED M. A. Atwood
ENGINEERING DEPT
ACTUAL COST ACTUAL DELIVERY

I HAVE EXAMINED THE ABOVE ESTIMATE AND ACCEPT / REJECT AS A CHARGE TO MY DEPARTMENT
DATE 4/30 19 34 SIGNED O. A. Elwin
REQUESTING DEPT. HEAD

APPROVED L. M. Bennett WORKS MANAGER

EQUIPMENT ORDER OBWM-296

Figures 2 and 3. It is no part of the inspector's job to see that his recommendations are followed. Replacements and repairs are distinctly the responsibility of the foreman and the superintendent

or because of the necessity of shutting down the machine at an inconvenient time.

Decision is also reached as to the desirable frequency of inspection. This may be as often as once a week or as infrequently as twice a year. In some instances certain parts of a machine should be inspected more often than others. A separate inspection sheet is then made out for each inspection.

The method of using the forms is to arrive at the proper scheduling of inspections for the individual machines, then to divide the work in such a way that the inspector will have approximately a like amount of work to do each day. For this purpose a tabulation lists machines vertically, inspection periods horizontally. Check marks are then filled in by the trial-and-error method until a reasonable assignment is arrived at for each day's work. Total inspection time will depend on the size and nature of the plant, but the job is ordinarily a part-time assignment.

The personal relationship aspect of the job is of great importance. The inspector must, in shop parlance, "know his stuff." Also he must be disabused of false ideas as to his responsibilites. His job is to see that conditions which, in his opinion, require correction are reported to the responsible individuals. It is *not* his job to see that the recommendations are carried out, nor should he feel hurt or neglected if the room foreman or superintendent chooses to take a chance and defer the repair.

Our customary procedure is for the foreman to pass his copy of the inspection form to the superintendent with the course of action indicated. If repair orders (Figures 2 and 3) are entered, it is the foreman's responsibility to see that these orders are properly carried out.

Responsibility

This responsibility phase has proved to be the keynote to the success of the plan. The inspector must feel that he has done his part effectively when he has called attention to defective conditions. The foreman and the superintendent must learn to regard the inspector's activities, not as criticisms of their machine maintenance, but rather as aids to their own vigilance. In some instances where repairs are deferred, the condition will still exist at the next inspection; in such instances the inspector will again note the condition as he finds it.

This program has been successful in our organization. It has been our experience that both foreman and operators are vigilant in their attention to those parts of the machine which are directly involved in the production of goods, but inclined to be less attentive to bearings, gears, and the like, which, while essential parts of the machine, nevertheless are not thrust upon their consciousness in day-to-day operation, and the value of the program has been particularly evident in connection with those parts of the equipment.

We have found this inspection scheme inexpensive to maintain and valuable in minimizing lost time due to machinery breakdown. We have further noted a significant curtailment in the cost of repairs, because minor adjustments are often sufficient to postpone indefinitely the replacement of parts which otherwise would have become necessary in a comparatively short period of time.

Now's the Time to Put Buildings in Shape

G. W. Borden

Construction Engineer
New York Dock Company, New York

A PREVIOUS article, June issue, discussed the procedure in making a systematic survey of the exterior surfaces of buildings, to determine the kind and extent of repairs needed. Preparation of masonry for repair and painting was also considered.

After the caulking has been completed a two-coat painting job consisting of an oil primer and a finish coat of any color desired can be applied. The oil penetrating the masonry or wood adheres strongly to these surfaces and in turn helps to hold the finish coat, which should be partially or in whole a metallic or gloss paint impervious to moisture.

Oxides of lead, either red, blue, or white in a vehicle of linseed oil have been found to be the most effective for priming, but unless protected in turn by an impervious coat of paint they will not last long. Red lead under ordinary climatic conditions is probably the best primer for metal, whereas in the case of masonry or wood where penetration is necessary the linseed oil vehicle is the important constituent of a priming mix, the body or color being used mostly to cover. Blue lead is advocated more for the priming of interior metal surfaces. White lead or zinc in a linseed oil vehicle is a satisfactory primer for wood on either interior or exterior surfaces. The best product for any immediate need can easily be ascertained from reliable paint manufacturers. This advice is free and if followed carefully will give gratifying results.

In this field, as in any other, the price of the better product is higher. A job is worth only what it costs. There may appear to be bargains at times, but they are likely to be only deferred liabilities.

With all wall surfaces made smooth and properly protected moisture will be kept out and it will be necessary to maintain only the painting and caulking. With a yearly inspection each summer and a small amount of "touching up," repainting should not be needed for eight or ten years. In fact, weatherproofing contractors will guarantee their materials and workmanship for periods of from three to five years and make annual inspections and small repairs, all for the original contract price.

The cost of cleaning, caulking, and applying two coats of paint to exterior surfaces, with a three-year guarantee of maintenance, will range from 5 to 10 cents per sq.ft. of wall area, depending upon the size of the building and its condition.

Age of a building is not so important as how well it is kept up

In connection with wall preservation, there are other very important items that should not be overlooked. They include copings, bulkheads, penthouses, parapet walls, and any other wooden or masonry roof appurtenance which should be treated in the same manner as main walls. These seemingly unimportant areas, although often neglected, are sources of great damage and high repair costs if not given timely attention. These are all parts of the protective chain of weatherproofing.

In the matter of roof and flashing maintenance, it should not be necessary to say much. Everyone knows that all leaks and defective parts should be repaired as soon as noticed. There is one item, however, that is often neglected, although it is usually evident in paper roofs of built-up composition after a few years of use. This item is blisters in the outer layer which, although pliant when warm, may and very often do break in cold

weather if stepped upon, thus permitting the entrance of water which will freeze and peel off more of the surrounding area until a leak may develop.

It is advisable to slit these blisters and cement the protective felt down with a cold plastic asphalt, covering the blistered area with at least one layer of 15-lb. rag felt which is in turn held in place and covered with plastic roofing asphalt. All paper edges if loose or curling, either on the main roof or part of the flashing, should be recemented to prevent ice in cold weather from causing any further peeling due to expansion.

All metal on roofs should be kept well painted, especially parts which although not easily seen can and will collect moisture and allow rapid corrosion if not protected. If the roof metal is copper corrosion will, of course, be very slow; however, a coat of paint will prevent it and add to the appearance.

Skylights and other glass throughout the entire building should be set with a plastic putty that will not harden, first, for easy removal in case of breakage of the panes, and because of the better adhesion, which will keep ice from pushing it off in winter. This precaution is sometimes overlooked.

Gutters and leaders should also be well inspected and all fastenings and soldering be made secure because the added weight of ice and snow in winter will often cause the fastenings under the roofing and in the walls to pull loose with the resultant penetration of water. Formation of ice in or on these parts in winter often becomes hazardous to passers-by as well as to the building itself.

This danger can be eliminated by the use of common table salt or of calcium chloride which, if thrown into the gutter or leader, will slowly loosen the ice. Thawing can be brought about more rapidly by passing an electric current through the leader for a short time thus heating it and loosening the ice so that it can be removed at once. This is also a highly satisfactory way of thawing frozen water lines where protection is impossible or inadequate.

Interior Surfaces

Maintenance of interior surfaces and equipment is a problem constantly confronting property owners, which involves renewal, replacement, or repair due to obsolescence or deterioration. Each of these procedures represents a separate undertaking.

Deterioration may be considered as due to three principal causes: (1) The action of the elements; (2) the chemical action of manufactured products or their constituents before manufacture; (3) wear and tear caused by usage.

If the exterior is well preserved, deterioration by the elements is a secondary matter, since it necessitates the presence of moisture and in the case of masonry or wood, where only moisture in the air may come in contact with them, it is so slow as to be almost negligible. Metals, especially iron and steel, oxidize quite readily and require a protective coating which may be either a covering, or paint, or both. Paint is the best protection against this kind of oxidation of metals, but in the case of areas subject to high temperatures, acid fumes, or mild wear a suitable covering should be put over the paint to protect it.

Chemical Deterioration

Chemical deterioration which is the result of manufacturing processes is usually due to acids either in the form of fumes which attack all parts of a building, or the acid itself either in strong or diluted form which may rapidly eat away or decompose piping and floors. The best way of preserving pipe lines and drains is to make them of acid-resisting material. The preservation of walls, columns, ceilings, sash, and so on, can usually be assured by the use of asphaltic paints.

Likewise, floors subject to wetting by acids can be preserved by the use of asphalt coatings usually varying in thickness from 1 to 4 inches and composed of different mixes, depending upon the usage of the area so treated. Concrete is no exception to the action of acids and it is also affected seriously in certain food-product factories where it is subjected to sugar or brine. In all such cases, protection with an asphalt coating has usually proved to be satisfactory.

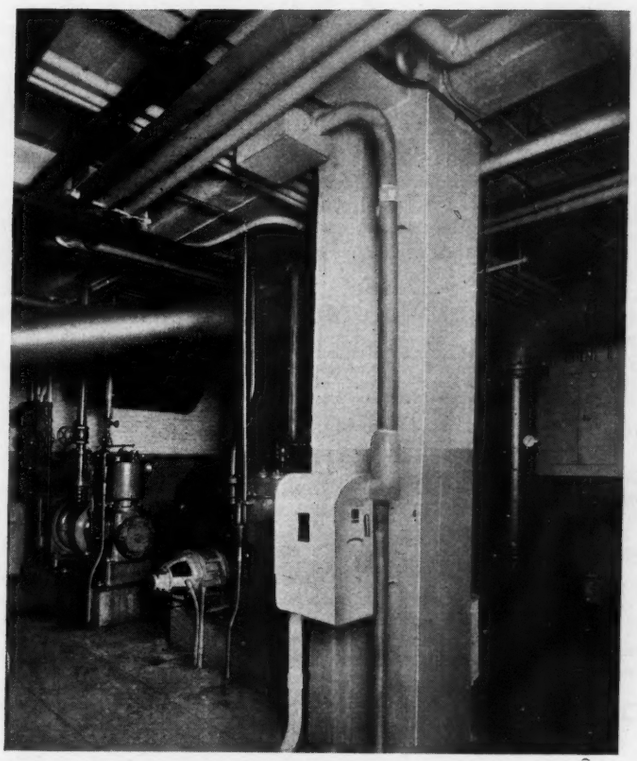
(Continued on advertising page 60)

Inspection of Interior Parts

Items	*Inspect For*	*Check Need For*
MAIN STRUCTURE		
WALLS	Holes, cracks	Pointing, painting
COLUMNS	Cracks, any evidence of weakness; general condition, including caps, bases, footings	Pointing, painting, strengthening
GIRDERS	Cracks, any evidence of weakness; general condition, including bearings, connections	Pointing, painting, strengthening
BEAMS	Cracks, any evidence of weakness; general condition, including bearings, connections, bridging	Pointing, painting, strengthening
CEILINGS	Cracks, loose parts	Pointing, painting
FLOORS	Cracks, holes, other evidence of failure	Replacements, resurfacing
SECONDARY STRUCTURE		
PARTITIONS	Holes, cracks, stability	Glazing, pointing, painting
DOORS	Cracks, loosening of parts, condition of hardware	Caulking, glazing, painting, other repairs
SASH	General condition, including sills, lintels, locks, chains or ropes	Caulking, glazing, painting, other repairs
SHAFTWAYS	General condition, including openings, doors, safety guards	Painting, repairs
RAMPS	Stability, condition of surface	Strengthening, repairs or replacement of surface
PLATFORMS	Stability, condition of supports and surface	Strengthening, repairs or replacement of surface
STAIRS	Stability, condition of treads, rails	Strengthening, repair or replacement of treads

All items that are found to be in need of maintenance attention should receive it at once. Delayed maintenance can result only in further depreciation and additional costs, because defects and decay tend to spread rapidly into the adjacent areas.

To Estimate Wiring Costs



Bends and offsets increase the cost of installing conduit. When estimating installation cost, make ample allowance for them

Montrose Edmonds

Electrical Engineer
Fischbach and Moore, Inc.
New York

PRACTICAL methods of determining and listing the amount of wire and material needed for a job were described in June. After listing and pricing the materials the final step is to estimate the time required for installation. A labor unit must be selected and the simplest and most logical is the man-hour. Let us first analyze the conduit installation.

A comparatively short time will be required to line up the conduit run, and although it should be, it is usually not considered. The time required will depend on the size of the conduit, the construction of the building, the number of bends, offsets, or saddles, and the amount of cutting and threading. Obviously much more time will be required per unit of length and size to run conduit between motors and starters located adjacent to them than to run feeder conduit, or conduit between panelboards and starters, where the latter runs are much longer. The location of the conduit with respect to machines also plays an important part. For example, conduit run on the ceiling parallel to an aisle space can be installed much faster than where it is run above machines. Incidentally, the time lost in climbing up and down ladders and moving them around is a large item, usually not given proper consideration.

Another factor which may be overlooked in estimating labor costs is the nippling required at panels and between panels, switches, and starters.

Naturally, the man-hours required for installation will vary with the size of the conduit. Also, it will take longer to install conduit on brick than on wood, or on concrete instead of on brick. Conduit can be installed quickly in a modern factory of steel and brick construction with sawtooth roof, say, because of the ability to use clamps designed for the purpose. Where it is necessary to drill and tap the steel, much more time is required.

The time needed to install conduit fittings and straps is included with the installation of the conduit. However, where a number of conduits are run parallel and may be supported on common hangers, it is better to place a separate time on the installation of hangers. This method is more accurate and will show a saving in the estimated time required to install the conduit. The table gives a fair average of the time required by workmen of ordinary ability to install conduit and other equipment under the conditions usually encountered. However, each installation must be studied carefully before making a definite estimate.

Time required to mount switchboxes, control devices, panel boxes and so on is next to be considered. Again the type of building construction is important, since equipment mounted on concrete will take longer to install than on a brick wall, because bolts and expansion shields must be put in. Frequently the time required to mount this equipment is lumped in with the time to connect it,

Average Time Required to Install Wiring and Equipment

CONDUIT

Number of Feet Per Day, Equivalent to 16 Man-Hours*

Sizes, Inches	On Concrete	On Wood	On Hangers	Number of Offsets Per Day
3	50	80	120	4
2½	60	90	160	6
2	80	120	300	12
1½	100	160	400	16
1¼	100	180	500	16
1	100	200	...	32
¾	150	220	...	...
½	160	240	...	...

Elbows, condulets, and other fittings are included.**

HANGERS

	On Concrete	On Wood
Medium	½ man-hour	.....
Large	1 man-hour	.....
Medium	.....	¼ man-hour
Large	.....	¾ man-hour

WIRE AND CABLE

(a) Based on runs of 75 to 100 ft., average length, such as feeders.* Multiply by 3 for total length of wire.

400,000 to 500,000 circ. mil. cable,		12 man-hours per run
4/0	to 300,000 circ. mil. cable,	8 man-hours per run
1/0	to 3/0	6 man-hours per run
No. 4	to No. 1	3 man-hours per run

(b) Based on motor branch circuit runs averaging 50 ft. per run. Multiply by 3 for total length of wire.

No. 8 to No. 6	1 man-hour per run
No. 14 to No. 10	¾ man-hour per run

(c) Branch circuit lighting.

No. 14 or No. 12 3,000 to 4,000 ft. per team day (16 man-hours)

PANEL BOXES (MOUNTING ONLY)

	On Concrete	On Hollow Tile
Small	1½ man-hours	1 man-hour
Large	3 man-hours	2 man-hours

LINE STARTERS, CABINETS, SWITCH CABINETS, SAFETY SWITCHES (MOUNTING ONLY)

	On Concrete	On Wood
30 or 60 amp	1 man-hour	½ man-hour
100 amp	1½ man-hours	1 man-hour
200 amp	2 man-hours	1½ man-hours
400 amp	2 man-hours	1½ man-hours

REDUCED-VOLTAGE STARTER CABINETS (MOUNTING ONLY)

	On Concrete	On Wood
Average size	4 man-hours	3 man-hours

CONNECTING SWITCHES IN PANELS, SEPARATE SWITCHES, OR STARTERS *** and ****

No. 14 to No. 10 lugs	1 man-hour per 3-pole device
No. 8 to No. 6 lugs	1½ man-hours per 3-pole device
No. 4 to No. 1 lugs	2 man-hours per 3-pole device
1/0 to 3/0 lugs	3 man-hours per 3-pole device
4/0 to 500,000 circ. mil. lugs	6 man-hours per 3-pole device

SPLICES OR TAPS (INCLUDING TAPING) ***

No. 14 to No. 10 wire	4 splices per man-hour
No. 8 to No. 6 wire	3 splices per man-hour
No. 4 to No. 1 wire	2 splices per man-hour
1/0 to 4/0 wire	1 splice per man-hour
4/0 to 300,000 circ. mil. cable	¾ splice per man-hour
300,000 to 500,000 circ. mil. cable	½ splice per man-hour

SETTING AND CONNECTING DRUM CONTROLLERS

From 15 hp. to 25 hp., starting or speed regulating, and up to 50 hp., starting duty only, approximately 16 man-hours.

SETTING AND CONNECTING RESISTOR BOXES

With three phases in one box (starting duty), 8 man-hours per box.

With one or more boxes per phase, 4 man-hours per box. (Labor for making supporting brackets is not included.)

BRANCH CIRCUIT LIGHTING WORK ***

Lighting panels, average 16-circuit	16 man-hours
Lighting outlet boxes (concrete ceiling)	4 boxes per man-hour
Lighting outlet boxes (wood ceiling)	6 boxes per man-hour
Lighting outlet boxes (concrete wall)	6 boxes per man-hour
Lighting outlet boxes (hollow tile wall)	6 boxes per man-hour
Switches and receptacles	6 per man-hour
Ceiling receptacles	4 per man-hour
Drop cord fixtures	3 per man-hour
Conduit stem fixtures (small)	2 per man-hour
Conduit stem fixtures (large)	1 per man-hour

•

NOTE: This table should be considered only as a general guide, since the number of man-hours shown is based on the productiveness of electricians of average ability working under normal conditions. The figures apply particularly to a three-phase, three-wire system with exposed conduit.

* Conduit and cable, particularly in the larger sizes, and very often in the case of the smaller sizes, require the labor of two men for installation.

** Under normal conditions conduit fittings need not be considered separately, although each case should be treated individually.

*** The number of man-hours is based on conditions in the average industrial plant and for a medium-sized installation. For example, if only three or four three-wire splices were involved, at different places in the system, the electrician would do each job complete—skin the wires, join them, solder, and tape. Where a large number of splices are involved less time per unit would be required if factory production methods were followed; that is, first clean and join all wires, then solder all wires, and tape all the splices. This same principle applies also to installing switches, fixtures, and so on.

**** Connecting to switches in panelboards will require about one-half the time shown here, since only three lugs per switch require connecting.

but it is simpler to keep these two items separate, as shown in the table.

In considering the installation of wire and cable the number and length of the runs are, of course, the most important points. It will be noted from the table that the quantity of wire of a single size which may be installed in a given time will vary considerably. The item of measuring runs by means of a fish wire, where it is not feasible to measure otherwise, must be considered, as well as the time required to prepare the wire or cable for pulling. An excessive number of elbows or conduit fittings in the run will increase materially the time required to pull wire. Pull boxes also make for additional

(Continued on advertising page 60)

Rotor Windings

Half-Coil, Shoved-Through Type

A. C. Roe

SOME machines have closed or partly closed slots, and the rotor windings may consist of wire, ribbon, strap copper, or bar, which is fed through the top of the slot, or pushed through from one end of the core.

There are three varieties of the pushed or shoved-through type of winding used on stators or wound rotors: (1) The bar and end connector; (2) the one-turn, open-end, two-layer, diamond-shaped coil (Figure 1); (3) the half-coil, one-turn, two-layer winding (Figure 2). The last winding is widely used and is the most difficult to install. It requires attention to details and knowledge of the kinks used by experienced winders.

There are a number of small insulating details used in a winding of this type, and for satisfactory results they should be of the best quality obtainable. These items, slot and end insulation, consist of the formed slot cells (Figure 3), separators, fillers, wedges, and the material used between the end windings. There are also the wood wedges for use between the figure 8 clips when soldering and the wood blocks used at the ends of the slots for forming the open end of the coil.

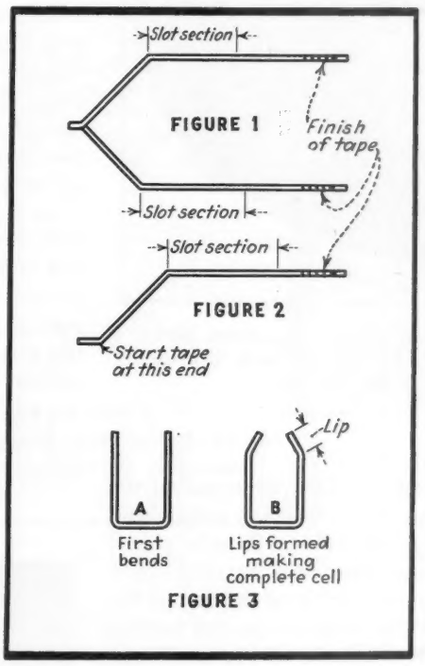


Figure 1. One-piece, open-end, one-turn, shoved-through coil for a two-layer diamond-shaped winding. Figure 2. Half-coil for a shoved-through, two-layer, diamond-shaped winding. Figure 3. Steps in making bent winding cells

The half or full coils have only one end shaped, as shown in Figures 1 and 2. The remainder of the coil should be straight and free from lumps or other defects. Of prime importance is the method of applying the tape; it should finish on the extreme end of the straight part. This will insure that the lap of each succeeding turn of tape is sealed, so that pushing the bar through the slot tends to iron down the lap, not lift it.

After insulating the coil supports, place the bent winding cells in the slots and apply paraffine to the four sides of the straight part of the coil.

Next, locate the collector ring end of the rotor, and start the bottom layer of coils in from this side. This means that when all the bottom coils are in place the formed ends of the bottom coils will be on the lead or collector ring side of the armature. The reason for this will be explained later.

When putting in the bottom layer of coils each one can be shoved through the full distance. It is easy to get the last few coils, throw coils, in. Simply lift the first few coils up to the top of the slot, which will permit passing the last coils under the ends of the first.

A steel wire band is then placed temporarily around the bottom layer coils on both ends (Figure 4), the object being to hold the coils rigid and prevent shifting during the forming of the coil ends.

With windings that use coils made from heavy copper, cut a set of wooden blocks having a radius on one corner, and long enough to make the bend at the right distance from the core. These blocks must be made thick enough, or fiber strips used (see Figure 5), to make them a snug fit between the coils where they leave the slots, and wide enough to come flush with the top of the coil.

With large rotors, or when coils of large copper section are used, block each slot and put a narrow temporary band over the blocks and coils, as shown at the left in Figure 4. This band keeps the blocks and coils in place while the coil ends are being bent and shaped.

When the coils are of light copper and easily bent, a dozen wood blocks will be sufficient. Put these all in place and as each coil is bent take the block from the rear and move it to the front.

After the bands and blocks are in place, bend the straight ends to their proper angle. To start, select any one slot and bend or spring the coil end in the right

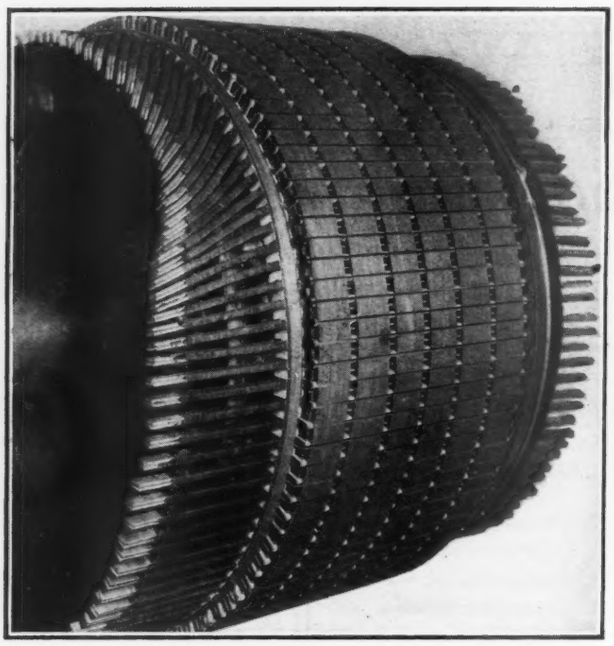


Figure 4. Rotor with all bottom coils in position, bending blocks at end of core, and temporary bands in place. Start of coil end bending can also be seen

direction as far as it will go, a distance equal to the width of one tooth. Do the same with the coils ahead until a place is reached where the full bend can be placed in each coil. Figure 4 shows where the bending starts at the center, and bends increase until at the top of the rotor a full bend is made. The angle of the full bend is made to match that of the opposite or formed end, shown in Figure 4 at the right.

Figure 5 shows in detail the full bends made in the bottom coils. It also provides a good view of the blocks and bent slot cells, the lap in the tape, and the method of insulating the coil support to form a solid bed for the coil ends.

After all the bends have been made, cut the bands and remove the blocks; then put fiber strips between adjacent coil ends to stiffen and tighten the end windings to prevent movement and chafing of the coils. In Figure 5, at the point where the full bend in the top coils ends, these strips appear sticking out past the insulation used between layers of bottom coil ends. This insulation between coil layers consists of three 0.030-in. layers of treated duck.

The next step is to put in the top coils. This requires more care than is needed for the bottom layer. The top layer is started on the side opposite the bottom layer start; that is, the top layer should have the formed end on the same side of the coil as the bottom layer of ends that had to be bent after all bottom coils were in place. This procedure puts the straight ends over the preformed ends of the bottom layer, and they are used as guides.

When starting the top layer do not push the first coil all the way through; push it about one-quarter of the way in and then try another coil inside, the position the last coil to be put in would take. Try these two coils until a position is found for the first coil that will allow the last few coils to be put in without bending the first coils out of shape.

Here is one of the worst places to make a mistake, since with this type of winding the start determines the amount of trouble that will be encountered in getting the last few coils in place. A little time and care in starting the top layer will save time at the finish.

The lighter and longer the coil, the farther in the first top coil may be pushed at the start.

After the proper position for the starting coil has been determined, put the second coil in and push it in a little farther; do this with each succeeding coil. The length of each coil and number of slots will govern the number of coils that will be left projecting out from the core—that is, not pushed home. After all the coils are started in their proper slots, go around the armature a few times pushing the coils in, a little each time, until all have been pushed home.

In a few cases it may be possible to push all the top coils through the full distance, and when the throw, or last coils, are reached the ends of the first coils in can be bent up enough to clear and allow the last coils to be put in. Care must be taken when bending or springing the throw coils not to run a twist or kink into the slot section.

[*The next article will give the details of forming the top coil ends and insulating between top and bottom layers.—Ed.*]

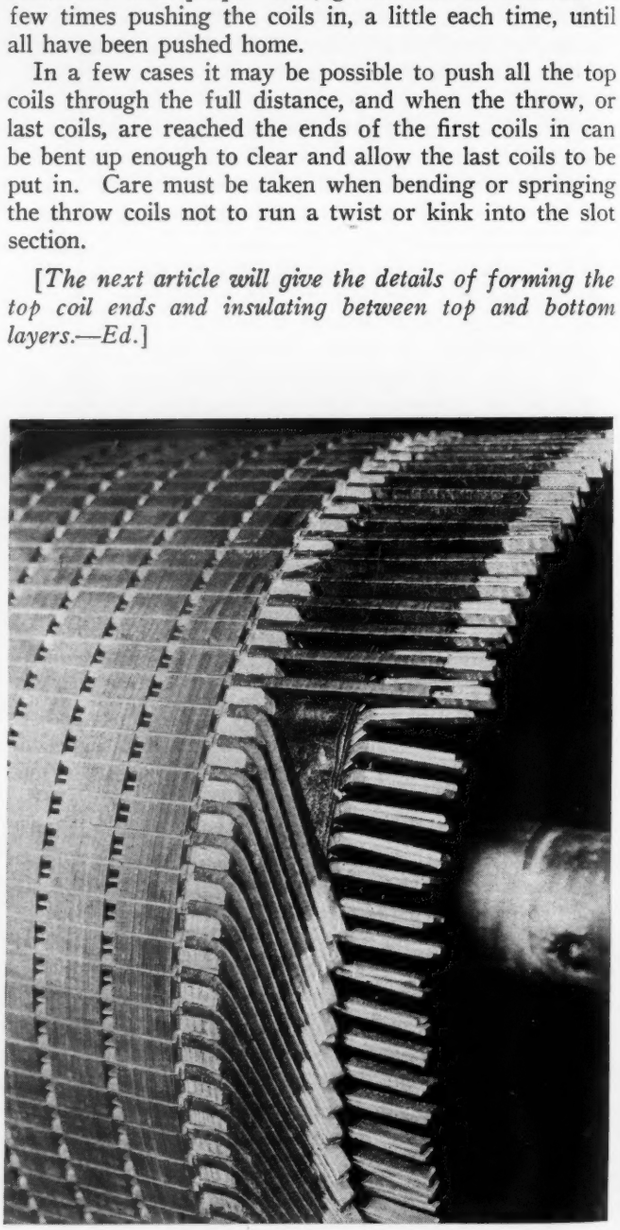


Figure 5. Where full bends are started, showing insulating pads between end windings, and fiber fillers between adjacent coil ends of lower layer

MAINTENANCE SHORTS

Sectionalized Lineshafting Reduces Power Losses

FRANCIS A. WESTBROOK
Center Conway, N. H.

Flexibility in the operation of a main lineshaft is provided for in a very simple manner in the metal stamping shop of Peter Gray & Son, Cambridge, Mass. A group of fifteen punchpresses is driven from a lineshaft, which is in one straight run, with countershafts for machines in out-of-the-way locations.

The main shaft is equipped with a coupling at about the midpoint, and each section is driven by its own motor. When orders are slack so that only a limited number of presses are needed, but the nature of the work is such that machines at different ends of the line must be used, the shaft is operated as a single unit and driven by one motor.

When the shop is busy the shafting is operated in two sections, each driven by a separate motor. This arrangement makes it possible to operate the motors close to rated load and efficiency at all times, and thus keeps losses down.

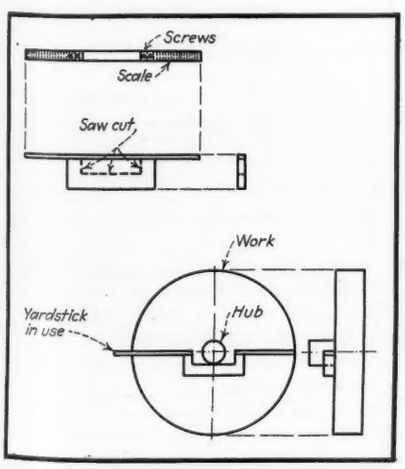
Mr. Westbrook's contribution has been awarded the $10 payment offered by the editors for the best Maintenance Short submitted during the past month.

Yardstick Clearance Gap

N. M. MOORE, Hamilton, Ont., Canada

One of the minor annoyances of the repairman's work is the difficulty of measuring the diameters of pulleys on shafts or with hubs which prevent a yardstick being placed flat across the center. The larger the diameter of the shaft or hub the greater the inaccuracy of the measurement.

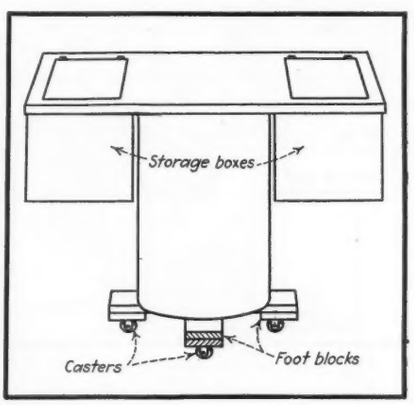
When I was ordered to take an inventory of pulleys to replace destroyed lists I nailed the yardstick to a piece of board in the center and then sawed out a gap. This left me both ends of the yardstick in the same position as when solid and gave me a clearance gap in the middle so that I could lay the scale right across the center and find the correct diameters of the pulleys.



Maintenance Bench That Goes to the Job

JOHN E. HYLER, Peoria, Ill.

An empty metal drum serves as a massive center column for a portable bench that makes repair work easier. It is mounted on a base made of two pieces of heavy plank, put together with a halved joint, by means of drilled and bolted angles. A foot-block is applied with screws at each of the four ends, which are then bored to receive standard, small-truck casters.



The top is secured to the drum from beneath with angle irons, and two storage boxes are made fast to the underside of the bench ends. They are used for storing tools, gaskets, bolts, pipe fittings, or whatever is needed, and are covered by hinged doors. Bit and chisel racks, and so on, may be mounted on the undersides of these doors. When closed the doors lie flush, leaving a level bench top.

Such a bench can also be built on a skid, and moved with a lift truck.

Electric Heat Aids Coil Assembly

SOURCE, Anaconda Wire & Cable Company, Muskegon, Mich.

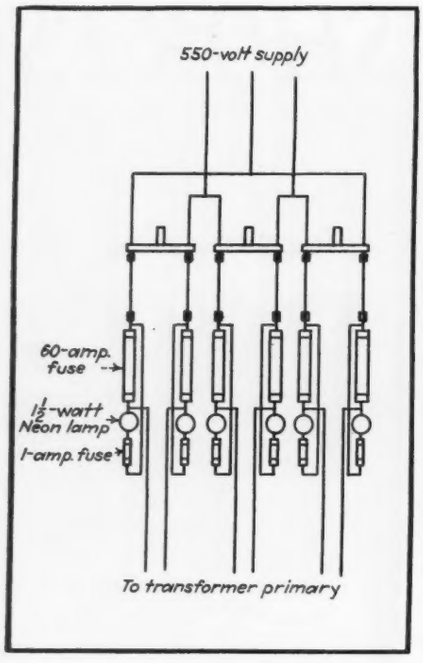
In the process of making certain types of coils, it is necessary to use both heat and pressure for putting on the end pieces. The heat has been obtained satisfactorily by inserting electric heaters in the face plate of the press. The plate is split and the halves are machined out to take one 350-watt ring-type heater and one 100-watt heater. Snap switches have been provided within reach of the operator so that varied temperatures can be obtained.

Lamp Lights When Fuse Blows

THOMAS G. ELLIS, Toronto, Canada

Recently I installed a switchboard in a large plant where "lights out" is a serious condition. In order to help the attendant locate blown fuses quickly the scheme shown in the diagram was worked out and is serving very satisfactorily.

A number of 550/220/110-volt transformers in scattered locations are fed from a 550-volt, three-phase service in the generator room. Each transformer is controlled by a separate two-pole, fused switch. A 1.5-watt neon glow lamp was connected in series with a 1-amp. fuse and put in parallel with each primary fuse. The 1-amp. fuses



are mounted on the back of the switch board.

When a transformer fuse blows, the primary current passes through the neon lamp, which lights up and shows the attendant that the corresponding fuse has blown. The small fuses protect the neon lamp sockets.

Incorrect Meter Reading Cause of Motor Trouble

R. H. Rogers, General Electric Company
Schenectady, N. Y.

One of the eight duplicate synchronous motors in a cement mill would fail to pull into step in about three starts out of four. After much discussion, during which it was practically decided to pull the motor down for overhauling, a portable meter was connected in the motor field circuit. It showed less than 75 per cent of the current indicated by the switchboard instrument. When full field was applied the performance of the motor immediately became normal.

All of the trouble was due to the fact that the wrong shunt had been connected in with the switchboard meter.

Handy Fuse, Circuit Tester

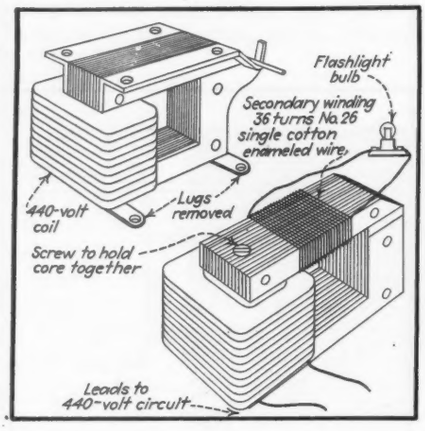
Chas. A. Peterson
Bendix Products Corporation
South Bend, Ind.

Use of two 220-volt lamps in series for testing 440-volt circuits and fuses is not very satisfactory, because the lamps are bulky and inconvenient and often break just when they are needed the most. To avoid these difficulties I made the tester shown in the sketch. It consists of a transformer not much larger than a tennis ball, and a flashlight bulb.

A discarded magnetic switch coil provided the transformer core and the primary coil. The lugs on the core iron were removed and the sharp edges ground off. A recess was ground out in the upper leg of the core to make room for the secondary winding. The flashlight bulb and its receptacle were the only items purchased. This bulb normally operates on one dry cell and is rated 1.25 volts, 0.60 amperes.

Since I did not know how many turns there were in the contactor coil which was used as the primary, the secondary winding was worked out by the "cut and try" method. Eventually it was found that 36 turns of No. 26 s.c.c. enameled wire was satisfactory.

The tester was mounted in a box made of sheet fiber, with a hole through which the lamp could be seen. Flexible leads to the primary coil were brought out opposite the test lamp.


Flashlight bulb
Secondary winding 36 turns No. 26 single cotton enameled wire
Lugs removed
440-volt coil
Screw to hold core together
Leads to 440-volt circuit

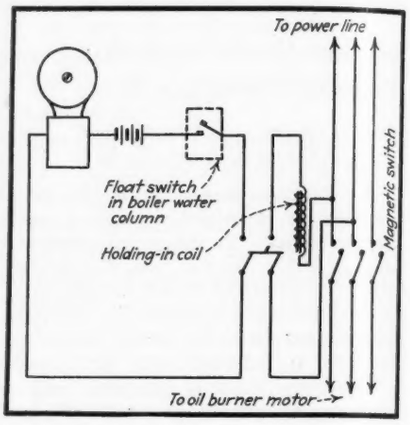
Making the Low-Water Alarm Neglect-Proof

G. W. Leck, Electrician
Radio Condenser Company, Camden, N. J.

Realizing that when the human element enters into the operation of an automatic alarm system a weak link has been introduced, we removed that weakness from the low-water alarm system of our boiler. When the alarm sounded the attendant would silence it by opening a switch and then shut down the fire and fill the boiler to a safe level.

It would have been possible for him to silence the alarm and then perform other duties before giving the boiler his immediate attention.

To eliminate this possibility we replaced the switch on our oil burner with one having an extra pole. The extra pole is connected in series with the alarm circuit and cannot be opened without stopping the burner. This is the only hand-operated switch in the alarm circuit and makes it impossible



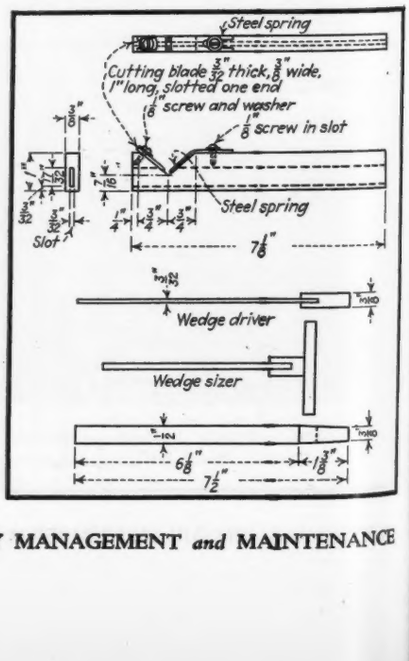
to silence the alarm without shutting down the fire. As soon as the boiler has been filled with water to a safe level the fire may be started and the alarm will remain silent until the next time that the water in the boiler reaches a dangerously low level.

Combination Wedge Sizer and Driver

William B. Cone, Chief Electrician
Shevlin-Hixon Company, Bend, Oregon

Fitting wedges in either stator or armature slots is a comparatively simple job if the wedges are the correct width. When they are not, which is often the case, the wedge sizer shown in the sketch will save time.

In operation the sizer is clamped in a vise, the cutting knife is set to the proper depth, and a plunger fitted with a T-handle is used to push the wedges



SPECIAL NOTICE

Until further notice, $10 will be paid for the best Maintenance Short submitted during each month. Other Shorts accepted will be paid for at attractive rates

through. This plunger is shorter than the wedge-driving plunger and just clears the cutting knife. When all wedges have been sized to fit, the cutting knife can be removed and, with the driving plunger, the tool can be used as a wedge driver.

A milling machine or shaper is used to cut the slot to the desired depth and width, which is then closed at the bottom. The plunger can be made from 12- to 18-gage saw steel or other suitable material. A good grade of tool steel is needed for the cutting knife.

Overloading of Crane Prevented by Mercury Switch

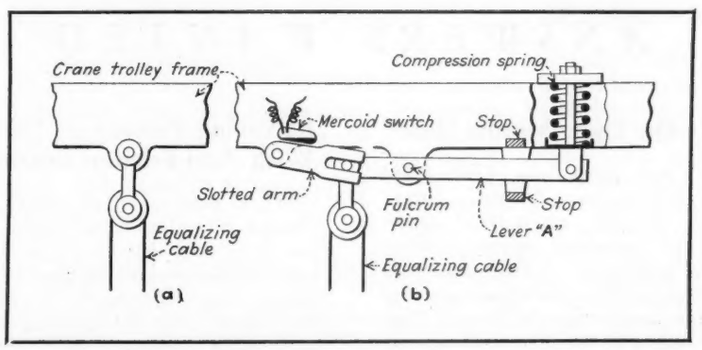
EZRA K. NICHOLSON, Cleveland

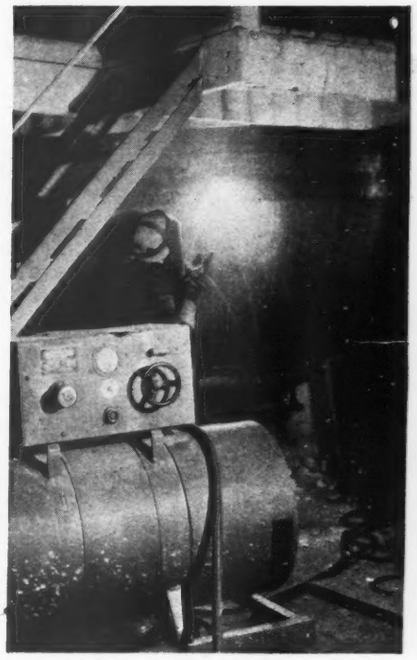
One of the usual forms of overload relay would ordinarily have afforded ample protection against the overloading of a crane used in removing the internal cartridges or chambers from synthesis tubes at the Belle, West Virginia, plant of the Dupont Company. These internal cartridges, however, sometimes expanded unduly within the synthesis tubes, so that instead of a steady pull being sufficient to remove them, it was necessary for the crane operator to substitute a succession of mild jerks.

In extreme cases this procedure resulted in an abnormal overload on the crane structure and motor, which was destructive mechanically as well as electrically. Although the motor was protected by fuses, these usually would not blow before a rather heavy physical overload had been imposed on the crane itself by the inertia of the moving parts. Consequently, it became necessary to substitute another type of protection which would take into account the space limitations as well as the requirement for safety in an explosive atmosphere.

In the illustration, diagram *a* shows the former arrangement used to hold the equalizing end of the crane cable to the crane trolley frame. Diagram *b* illustrates the new arrangement used to disconnect the source of power from the crane as soon as a predetermined load has been imposed on it.

The pin in the crane trolley frame was slightly displaced to provide a fulcrum for the lever, *A*. The equalizing end of the crane cable was attached to the shorter end of this lever and a semi-adjustable, coiled, compression spring was placed between the longer end of the lever and a projection on the crane trolley frame. Stops were provided for preventing an excessive amount of movement of lever *A* in either direction. A mercury switch, controlling the power to the crane, was attached to a short, slotted arm that was actuated by the shorter end of lever *A*. Operation of the crane, using the mercury switch, is now wholly satisfactory.





Brew Kettle Stretched to Double Capacity

SOURCE, The Lincoln Electric Company Cleveland

When a brewery in Milwaukee found that its 50-barrel capacity brew kettle was too small, it faced the choice of installing a new kettle or enlarging the old one—and chose the latter.

To do this, the spherical brew kettle was cut horizontally through the center. With the upper half elevated, four ⅜x66x84-in. sheets were inserted, lap welded over the exterior of the original kettle, and butt welded to each other. In this manner the capacity of the kettle was increased to 107 barrels a day, literally "stretched" to more than double its original value. The work was completed in two days.

Electric Heat Protects Sprinkler Valves

SOURCE, The Brunswick-Balke-Collender Company, Muskegon, Mich.

To prevent sprinkler valves located in unheated parts of its buildings from freezing, Brunswick - Balke - Collender built inclosures around the valves with several 100-watt lamps inside the inclosures. This did the job, but the cost of lamp replacements was excessive.

The company then substituted small 300-watt strip heaters mounted on the wall of each inclosure. Now for a few cents a day the sprinkler valves are kept from freezing even in sub-zero weather.

QUESTIONS and ANSWERS

Conducted by G. A. VAN BRUNT

Will This Transformer Connection Work?

At present we are operating one 600-kva., single-phase transformer to supply a flash welder and two 75-kva., single-phase transformers connected in open delta to give three-phase power for our motors. The large transformer is loaded to about two-thirds of its rating, whereas the two small ones are operating close to their rating. Would it be possible to operate these three transformers together in delta? If this could be done we could use the reserve capacity of the large transformer to good advantage to increase the capacity of the three-phase supply. We would, of course, continue to operate the welder from the 600-kva. transformer. What troubles are likely to be experienced with such a connection? *L.K.E.—Minneapolis*

THE TRANSFORMER connections proposed have given satisfactory results in other installations involving both single-phase and three-phase loads. Making this change to a closed-delta connection will increase the three-phase capacity of the transformer bank by nearly 42 per cent over the present capacity.

A consideration that may be overlooked when two single-phase transformers are connected in open delta and loaded up to rating is that their windings will be carrying about 15 per cent overload. This is a disadvantage of the open-delta transformer connection.

No serious trouble is likely to be experienced with the new connections. There may be some unbalance of the phase voltages, especially when the welder is in operation, but it will not impair the operation of the motors.

J. L. YOUNG, *St. Marys, Ohio*

Trouble in Operating Generators in Parallel

We are having trouble in getting two 150-kw., compound-wound, interpole generators to operate in parallel. They are directly driven by 436-hp., 2,200-volt synchronous motors. Generators and motors in both units are of the same make, size, speed, and so on, and both motors are supplied from the same line. Both generators are flat compounded and give the same voltage at the same loads, but when they are running in parallel one generator will gradually take on more and more load until the breakers trip. The next time the load comes on it may be taken up by the other generator. In other words one generator does not consistently carry more load than the other. The equalizer wire and buses are almost as large as the main leads; so I assume that they are of ample size. Can someone tell me why the generators will not run properly in parallel, and how to remedy the situation?

F.D.—North Hollywood, Calif.

DIRECT-CURRENT generators that have a drooping voltage curve are most stable in parallel operation, because it is a difference in the voltages of machines so connected that causes an uneven division of the load. With generators that have a rising voltage curve the difference between machine voltages tends to increase, once it is established. This is not true of generators having a drooping curve; added load causes a voltage drop and a tendency for each machine to give up, rather than take on, load. Hence, if such generators are reasonably well adjusted very stable operation can be expected.

Before making any changes in these generators all circuits and connections should be carefully checked. Since the generators are the same size the main leads on each should be the same size and length. The equalizer leads should be as short as possible and of sufficient size to make their resistance negligible. Also, the equalizer connection must be made to the end of the series field next to the armature. On generators having a divided series field—three-wire generators, for example—two equalizer connections are necessary.

To adjust the series field put one generator on the board and adjust the shunt field rheostat to give the desired

(Continued on advertising page 54)

ANSWERS WANTED

Why Do These Motors Heat?

We have three 2-hp., 1,800/1,200/900/600 r.p.m., 220-volt, three-phase, 60-cycle, multi-speed squirrel-cage induction motors driving three conveyors. These conveyors must all operate simultaneously and at the same rates of travel, corresponding to the four motor speeds given above. One drum controller was installed for the three motors, with one set of fourteen No. 8 wires, the connections to the motors being taken off at each location, which are about 100 feet apart. The motors operate satisfactorily at two speeds, but heat up badly at the other two speeds. All connections have been checked for correctness, there are no shorts or grounds, and the motors are not overloaded. Can anyone explain the cause of this trouble and how to correct it?

E.M.—Brooklyn, N. Y.

Replacing Pinions on Shafts With Anti-Friction Bearings

When putting on or taking off pinions or pulleys from shafts that are fitted with ball or roller bearings, is there much danger of injuring these bearings? I assume that more care is required than with plain bearings; so I should like to know what special precautions, if any, should be taken.

S.A.—San Francisco

Raising Generator Voltage

Current for our plating tanks is supplied by a 6-volt, 200-amp., 1,200-r.p.m., direct-current generator. Now we want to use another plating solution that requires a voltage of 7.5 to 8 volts. Is there any way of raising the voltage delivered by our generator without rewinding it? *A.D.F.—Chicago*

· EQUIPMENT NEWS ·

Water Mixer

Designated as Fulton Sylphon No. 904. Thermostatic. For use in connection with individual or gang showers, continuous flowing baths. May be used as maximum temperature limiting device in hot water lines or as auxiliary to ordinary shower mixing valve. May also be used alone to give hot water at controlled temperature. Fulton-Sylphon Co., Knoxville, Tenn.

Pump

Automatic, electric, sump and cellar drainer. Known as Model B-2400. Claimed by maker capable of pumping 2,400 gal. per hour at 1-ft. head, up to 400 gal. at 20-ft. head. Constructed of bronze with ¼-hp., rust-proof motor. Centrifugal pump, open-type impeller. Stainless steel shaft. Automatic control. Outlet tapped for 1-in. fittings for connection to hose of pipe line. M. L. Oberdorfer Brass Co., Syracuse, N .Y.

Steam Storage Systems

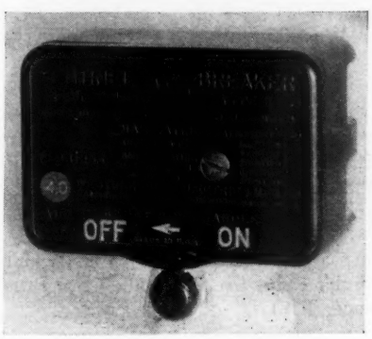
Foster Wheeler Corp., 165 Broadway, N. Y., has acquired exclusive rights for manufacture and sale of Ruths steam storage systems in U. S. and Canada. Business will be carried on by Ruths Accumulator Division of Foster Wheeler.

Motor Mountings

Flange head. For Louis Allis motors. Several types. Flange is integral part of motor head and may be finished on either or both sides. The Louis Allis Co., Milwaukee, Wis.

Sentinel Breakers

For protection of fractional-horsepower motors. Disconnecting. Permits sufficient time delay to start small motors having high starting current, but disconnects motors from line when stalled. Self-protecting element is combination of bi-metal and auxiliary heater, trip-free, cannot be held in "on" position while overload exists. Thermal heaters available in 19 ratings, from 1.4 amp. to 14.2 amp., for protecting motors with full-load ratings from 1.1 to 12.9 amp. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



Roller Chains

Stainless steel. Formerly made on special order. Now produced and stocked in commonly used sizes for immediate shipment. Made of solid 18-8 steel and recommended for use where corrosion is encountered. Diamond Chain & Mfg. Co., Indianapolis, Ind.

Spray Gun

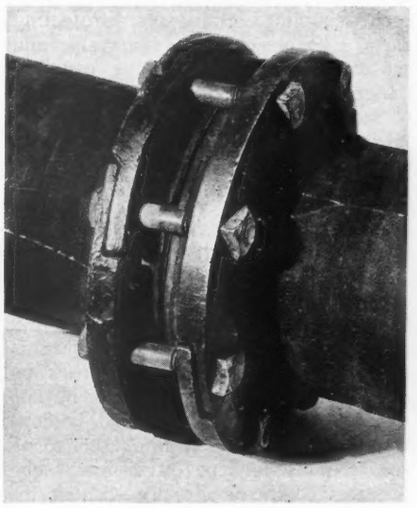
For production finishing operations. Called "Type MBC." One-piece air valve operated by heavy spring. Spray width adjustment valve on back of gun dialed to permit setting for each operation. Gun may be used with pressure, suction, or gravity material feed. Air cap has large number of openings for extremely fine atomization of lacquers, primers, surfacers, sealers, and ground coats. The DeVilbiss Co., Toledo, Ohio.

Welder

Production, seam. "1000 Series." For straight or circular seam welds in ferrous metals, corrosion-resistant steels, and, with slight modifications, in non-ferrous metals. Will handle work from 10½ in. in diameter by 12 in. in length to 40 in. in diameter by 45 in. in length. Welding speeds from 2 to 15 ft. per min., pressures from 650 to 1,400 lb. Transformer capacities from 100 to 250 kva. Thomson-Gibb Electric Welding Co., Bay City, Mich.

Ohmmeters

Midget "Megger," circuit-testing. Direct-reading, for resistance measurements as low as a fraction of an ohm and up to 200,000 ohms. Also claimed suitable for checking coils, rheostats, fixed resistances, continuity of circuits, and insulation resistance. Similar in size and appearance to Midget "Megger" insulation tester. Standard size 4½-volt dry cell provides testing current. Two scales with selector switch give two ranges. Cases of synthetic resins. James G. Biddle Co., 1211 Arch St., Philadelphia, Pa.



Hose Joint

Eliminates all contact between metal and fluid. Called "Flexseal." Designed as substitute for nipples and flanges, recommended for larger diameters of suction or discharge hose handling abrasive materials, acids, corrosive liquids. Hose end has enlargement reinforced with plies of fabric surrounding steel ring. Joint assembled with split flanges and standard bolts. Standard bolt spacing permits fitting hose end to standard pipe. Furnished in sizes 1½ in. and up. The B. F. Goodrich Rubber Co., Akron, Ohio.

Thermometer Controller

Mercury-switch, indicating, automatic. Capacities up to 15 amp. at 110 volts, 10 amp. at 220 volts; adaptable to one-, two-, or three-contact control or signalling systems. Same measuring system and control mechanism as Brown recording control thermometers. Furnished in circular 10-in. universal cases. Adaptable for control of pressure, liquid level, or other factors in addition to temperature. The Brown Instrument Co., Philadelphia, Pa.

Coupling

Flexible. Type WH. For positive, flexible connection between motor or engine and driven machinery. Compensates for slight misalignment. Consists of two cast-steel flanged halves, two sheet steel cover plates, two snap or retaining rings, and five to twenty-two flexible elements, depending on size. Rectangular slots machined radially around periphery of each flange receive cushioning elements of hydraulic pack-

ing. Torque transmitting elements are rectangular steel plates placed between cushioning elements in center of slots. Snap rings fit into grooves in flexible elements and periphery of coupling flanges to prevent radial or lateral movement. Smooth steel cover over each coupling eliminates projecting parts. Flexible elements removable and replacable without disturbing coupling flanges, motor, or machine. No metal to metal contact of wearing parts—no lubrication necessary. Rated for speeds up to 8,000 ft. per min. Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.

Timer

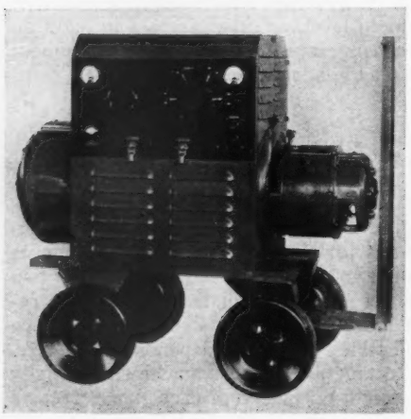
Electronic. For use in timing current flow on such operations as spot and projection welders. Type HA. Measures pre-set length of time and closes or opens contact for that time after initiating impulse. Time measured is continuously adjustable from $\frac{1}{10}$ sec. to 45 sec. Industrial-type grid-flow tube operates contactor directly without intermediate relays. Capacity 10 amp. at 115 volts, 5 amp. at 220 volts, a.c. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Compressors

Oil-engine-driven, portable, air. Two-stage. Six sizes now available for oil drive as well as for gasoline-engine drive. Capacities of 75 to 500 cu. ft. per min. Oil engine, "Type H," is 4-cycle, solid-fuel-injection, spark-ignition. Ingersoll-Rand Co., 11 Broadway, New York.

Welder

Portable, arc. Rated 200-amp., 40 volts. Has four main current steps, more than 600 adjustment steps ranging from 60 to 250 amp. Weight, 1,500 lb. Eliminates need for reactors by obtaining arc stabilization through adjustments within welding generator itself. The Universal Power Corp., 1719 Clarkstone Road, Cleveland.



Conduit

Electrical, metallic. Called "Electrunite Steeltubes." Has entire inside surface covered with small, round raised knobs, claimed by the manufacturer to reduce wire-pulling friction 30 per cent. Requires no threading in installation. Bends easily. Electrical Division, Steel and Tubes, Inc., Cleveland.

Socket

Three-circuit, lamp. For applications requiring two or three intensities from same lighting unit. Similar to mogul porcelain socket, but has floating center contact for high wattage lead. Ring contact for low wattage lead surrounds center contact, and shell provides common lead. Supporting screw spacing same as on mogul socket. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Pipe

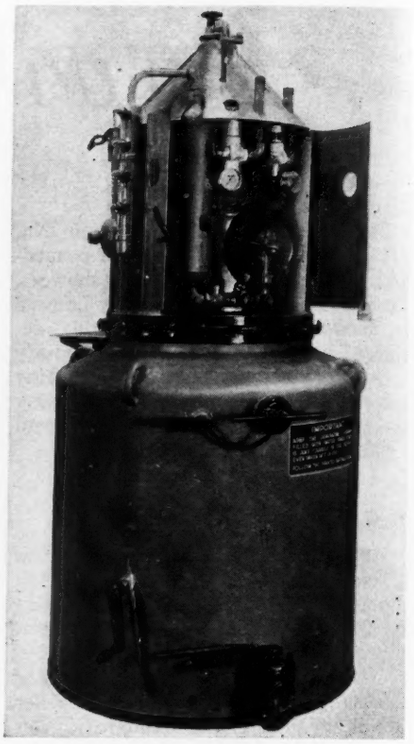
Corrosion-resisting. Called "Leadhesion." For acid and brine equipment, heat-exchanger apparatus, and installations handling corrosive liquids and gases. Standard and special straight lengths, thick and thin-walled, variety of metals, outside protected by coating of chemically pure lead, antimonious lead, tin-lead or tellurium-lead. Gross Engineering Corp., 3955 West 25th St., Cleveland.

Operation Recorder

Spiral-record, cam-operated, electrical. Record starts at outer edge, works inward. Particularly adaptable for time-study work. One type provided with chart driving clock, making one revolution per hour, and with separate telechron-motor-driven cam making one revolution in 8 hours. Operation-recording mechanism is electromagnet which is energized when external circuit is closed, actuating pen arm and moving inking pen $\frac{1}{16}$ in. Entire movement housed in moisture-proof, rectangular, model 40M case. The Bristol Co., Waterbury, Conn.

Combination Tool

For extracting fuses and testing open circuits, blown fuses, base receptacles, grounded fixtures. Called "Test-Pliers." Made of bakelite and fibre. Testing device is carbon lamp in series with 1,600-ohm resistance. Rated for 110 and 250 volts. Lamp will light on 65 volts. With resistance removed, has range of 30 to 110 volts. Lamp takes 0.08 amp., gives red glow when there is current on line. One end of tool for testing, other end has pliers for removing fuses. Star Fuse Co., Inc., 235 Canal St., New York.



Welding Generator

Portable, acetylene. Called Oxweld Type MP-4. Intended for portable service only. Carbide capacity, 150 lb. of $\frac{1}{4}$x$1\frac{1}{2}$ in. (quarter size). Rated to product 300 cu. ft. of acetylene per hour. Weight, 750 lb. empty. Over-all height, 87 in., diameter. $42\frac{3}{4}$ in. Gravity feed, with feed control unit self-contained inside carbide hopper. Oxweld Type R-56 regulator removes slight variation of pressure within generator. No exposed piping on generator except outlet manifold. Designed for maximum ease of maintenance. The Linde Air Products Co., 205 East 42nd St., New York.

Shower

Semi-circular, group. Accommodates 3 users at once, each in separate compartment. Requires 3 plumbing connections, two supplies, one drain. Mixing chamber reduces scalding hazard. Framework is seamless steel tubing, partitions heavy leveled sheet, entire unit finished in grey, baked enamel. Equipped with white duck curtains. Supply connections from above or below. Bradley Washfountain Co., Milwaukee.

Paint

"Barreled Sunlight." Now offered with five improvements: increased light reflecting properties, resistance to "yellowing," spreading power, hiding power, and ease of flow. Supplied in cans, 5-gal. buckets, drums. U. S. Gutta Percha Paint Co., 19 Dudley St., Providence, R. I.

Truck

Heavy-duty, low-lift, 5-ton capacity. Known as Mercury EL Model A-1010. Hydraulic lifting system, magnetic-contactor control, double-reduction bevel- and spur-gear-drive axle, semi-elliptic spring suspension, brakes in wheels, positive and automatic overload protection. Four-wheel trailing axle. All six wheels steer. Mercury Mfg. Co., Chicago.

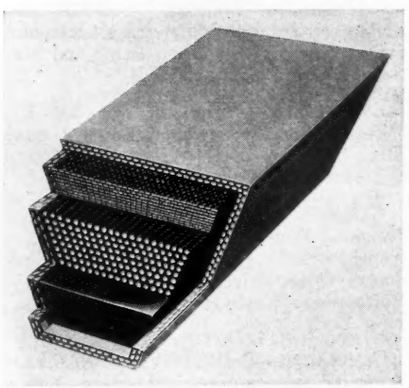
Insulating Blocks

For temperatures up to 1,900 deg. F. Made from calcined diatomaceous silica, blended and bonded with asbestos fibre. Low thermal conductivity, negligible shrinkage. Weighs 23 lb. per cu. ft. Standard sizes, 3x18 in. and 6x36 in., flat and curved, 1 to 4 in. thick. Johns-Manville, 22 East 40th St., New York.

Motor Starter

Weather-proof, dust-tight, oil-immersed, across-the-line. For motors up to 15 hp., 220 volts, and 30 hp., 440-550 volts. Called Type ZO. Inclosed in bonderized, black enameled case. Self-contained ammeter in dust-tight case can also be furnished. Starter arranged for remote control, push button automatic operation. The Electric Controller & Mfg. Co., 2700 East 79th St., Cleveland.

Belts



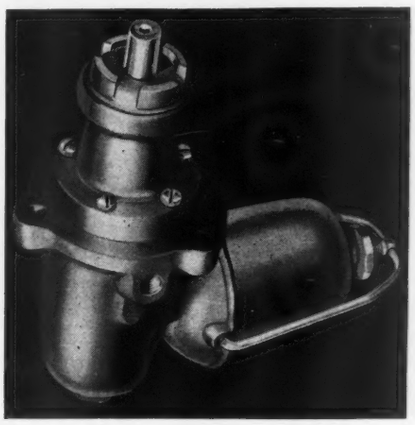
Multi-V. "Improved" construction has three layers balanced to resist stretch and cover wear. Compounded to reduce internal heat. The B. F. Goodrich Rubber Co., Akron, Ohio.

Valve

Synchro, diaphragm motor. For use on air-operated control systems. Claimed to respond immediately to air-pressure changes. Has same stem position for given pressure whether pressure is rising or falling. Also claimed to have no hysteresis or friction loss in top movement. Rubber diaphragm. Stem packing renewable without disturbing adjustment. Top may be renewed or spring replaced without changing setting of spring follower. Union and valve bodies of V-port or single-seated construction available with various body materials and trim. The Bristol Co., Waterbury, Conn.

Fuel Unit

Automatic. For pressure-atomizing oil burners. Includes automatic variable-displacement rotary pump. No valves,



no pistons. Claimed to pump automatically correct volume of fuel without requiring adjustment for different sized nozzles. Automatic air relief. Mechanical seal. Pressure adjustment. Sundstrand Machine Tool Co., Rockford, Ill.

Converters

Inverted, for use with small machine tools where only d.c. supply is available. Sizes from ½ to 20 kv.-amp., single phase. For changing 115 volts d.c. to 110 or 220 volts a.c., and 230 volts d.c. to 110 or 220 volts a.c. Field structure serves both windings, is identical with that of standard d.c. motors and generators. Readily portable. General Electric Co., Schenectady, N. Y.

Scale

Cabinet-type, dormant, platform. One to four unit weights controlled by handles add capacity-of-dial weights to system. For use where heavy loads are weighed by small increments and finely graduated dial is impractical. Has standard Kron free-floating platform, one-cam-translation ball-bearing-type indicating mechanism. The Kron Co., Bridgeport, Conn.

Steam Trap

For handling condensation in any plant using steam for heating, cooking, machinery operation, generation of power. Employs float principle. Powerful leverage permits discharging all condensation as fast as it enters trap, manufacturer claims. Not affected by pulsating pressures. Water level covers valve mechanism to prevent wire drawing, water hammer, wear. Renewable phosphor-bronze valveseat. Reversible and renewable monel-metal valve stem with two-bearing alignment. Nason Mfg. Co., 71 Beekman St., New York.

Hose

Paint-fluid. Claimed to resist all commercial solvents and last four to twenty times as long as rubber-compounded hose in service. Called "Electric" (DB Type). Made of compound said to possess strength and flexibility of rubber but not to disintegrate when in contact with oils or solvents. Braided and molded construction. Sizes, ¼, 5/16, ⅜, 7/16, and ½ in. inside diameter. Lengths up to 500 ft. Electric Hose and Rubber Co., Wilmington, Del.

Instruments

Portable, measuring. Types NPD, d.c., and NPA, a.c.. For general testing purposes and for use as secondary standards. Line includes d.c. ammeters, voltmeters, millivoltmeters, and milliammeters of all ranges; a.c. voltmeters, ammeters, wattmeters, and power-factor meters. Cases have outer walnut shell with two-piece iron inner case, provide magnetic shielding, protection from strain, dust, and moisture. D'Arsonval type mechanism. Scale length, 5¼ in. Voltmeters self-contained up to 750 volts, ammeters self-contained up to 75 amp. Also portable d.c. shunts, 50-millivolt drop, mounted on bases of insulating material. Roller-Smith Co., 233 Broadway, New York.

Combination Tool

For testing, removing or inserting fuses from 30- to 100-amp. capacity, testing circuits of from 110 to 550 volts, handling all types of "live" electrical parts, adjusting loose cut-out clips, etc. Called Ideal Combination Test-Lite and Fuse Puller. Made of reinforced bakelite. Like a pair of pliers, with test pins mounted on handle ends, test light inclosed in handle. Length 7 in. Ideal Commutator Dresser Co., Sycamore, Ill.

Relay

Photoelectric. For operation on changes in illumination as small as one foot candle (with G-M No. 1217 light source, can be operated at 90 ft. with white light, 40 ft. with infra-red invisible beam). No. 1217 light source furnished with 60-volt lamp having rated life of 3,000 hr., also condensing lens and adjustable-focus lens tube. Provides 30 foot candles of white light

at 10 ft., one foot candle at 90 ft. Relay operates on 110-volt, 60-cycle a.c., is normally supplied with contacts having 2-amp., a.c., non-inductive load capacity. Claimed to operate consistently at 600 per min. G-M Laboratories, Inc., 1731 Belmont Ave., Chicago.

Smoke Recorder

Photocell. Compensated for variations in light source. Operated by Galvatron electronic relay circuit. Consists of receiving element for mounting on individual boiler panel board, transmitting element consisting of projecting cylinder, and detecting cylinder. Makes continuous record of relative smoke density on 12-in. chart. Bailey Meter Co., 1050 Ivanhoe Road, Cleveland.

Instruments

Portable, indicating, for test departments, laboratories. Type PX-5. For d.c. service. Line includes: Milliammeters, microammeters, ammeters, voltammeters, millivoltmeters, voltmeters, double-range voltmeters. Also high sensitivity movements using Cobalt steel magnets for special measurements. Molded Moldarta cases, 7¼x8⅛x4 in. Scale length, 5 in. D'Arsonval movement. Shielded from magnetic fields. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Lubricants

Called "Sta-Put." Consist of mineral oil treated with mineral hydro-carbons to increase ability to stay in place. Maker claims also increased load-carrying capacity by combining with other hydro-carbons. No deterioration or thickening in use or storage, according to manufacturer. E. F. Houghton & Co., 240 West Somerset St., Philadelphia.

Belting

The Fabreeka Belting Co., Boston, has changed name to Fabreeka Products Co. Reason, increased sale of Fabreeka material for uses other than belting. Main offices have been moved from 20 East St. to 77 Franklin St., Boston, Mass.

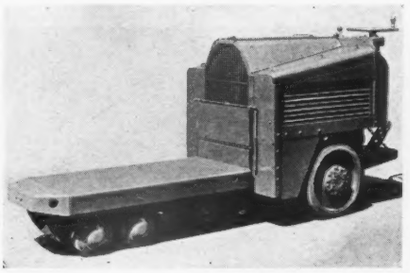
Valve

Hauck Micro Regulating. For regulating oil flow to burners in industrial heating processes and for controlling flow of fluids. Claimed suitable for use with all grades of oil, any type of burner. Enables duplication of setting. Operating handle moves indicator over graduated scale. For pipe sizes from ⅜ in. to 1 in. Capacities up to 1,300 gal. per hr. with light oil, 650 gal. per hr. with heavy oil. Hauck Mfg. Co., 126 Tenth St., Brooklyn, N. Y.

Out-Voltage Regulator

Gatherton. For limited-capacity distribution lines, industrial applications where voltage drops when motors start. No moving parts. Completely inclosed. Rated 50 Kva., 2,300 volts, single-phase, 10 per cent boost. Consists of electronic tube with booster and impedance transformers. Roller-Smith Co., 233 Broadway, New York.

Truck



Gas, lift, industrial, 3-ton capacity. Two speeds forward, two reverse. Single pedal controls both brake and clutch. Releasing pedal disengages clutch and applies brake. Hydraulic hoist mechanism has pump driven by motor. Elwell-Parker Electric Co., Cleveland.

Arc-Welding Head

Automatic. Type WFA. One small rheostat only adjusting element. Small motor drives electrode feed rollers through worm reduction gear and three-speed transmission. At any of three speeds, suited to electrode size, current, and rate of deposition of metal, maker claims electrode is fed at uniform rate and arc voltage is accurately maintained. Handwheels swing nozzle through complete circles in two planes at right angles. Head and control arranged for operation from 60-volt d.c. supply. General Electric Co., Schenectady, N. Y.

Welding Electrodes

Coated, for high-carbon and high-strength steels. Called "Murex Special A." Claimed to hinder migration of carbon from parent metal to deposited metal during welding and assure sound, dense, ductile, penetrating welds. Deposit contains small quantity of nickel, has tensile strength of 73,000 lb. per sq. in., yield point of 59,000 lb. per sq. in., elongation in 2 in. of 31 per cent, reduction in area, 63.5 per cent. Metal & Thermit Corp., 120 Broadway, New York.

Packing

For reciprocating and centrifugal rods. Known as Interlocked Braided Asbestos Packing. Has each strand of long-fibre asbestos yarn interlocked in braiding to provide packing with integral square braided structure. Recommended for packing against saturated or superheated steam, hot or cold, fresh or salt water, weak caustics and acids. Johns-Manville, 22 East 49th St., New York.

Geared Motor Reducers

Vertical. Three types. IX, for double or triple reduction, is integral unit corresponding to I type horizontal unit. One motor end bell is removed and stator close-coupled, through adapter, to gear case. Type ZX has all features of Z or U horizontal reducers. Any standard horizontal ball-bearing-type motor with feet is used unchanged, with resilient connection through Falk Bibby coupling to gearing. Ratios from 9.7 to 41.9 in double reduction and from 45 to 288 in triple reduction. Type LX, for single reduction only, corresponds to L type horizontal unit. The Falk Corp., Milwaukee.

Trade Literature

CLUTCH—Bulletin No. 103, describes the Hilliard over-running clutch.—The Hilliard Corp., 102 W. 4th St., Elmira, N. Y.

COMPRESSORS—Bulletin L-612-S28, describes refrigeration compressors, horizontal duplex type.—Worthington Pump and Machinery Corp., Harrison, N. J.

CONDENSERS — Bulletin W-200-B2, "Worthington Surface Condensers, Welded Steel Shell Design."—Worthington Pump and Machinery Corp., Harrison, N. J.

GEARS, DRIVES—Catalog 50, 240 pages, "Boston Power Transmission Products from Stock." Includes gears, speed reducers, chain drives, ball bearings, etc.—Boston Gear Works, Inc., 151 Lafayette St., New York.

GENERATORS—Bulletin GEA—1607A, concerns d.c. generators and exciters, 1 to 5 kw., Type B.—General Electric Co., Schenectady, N. Y.

GREASE GUN — Catalog page, describes "Triple 'S' Industrial Grease Gun" and attachments.—Specialty Sales and Service Corp., 138 Holden St., Minneapolis.

LIGHTNING ARRESTERS—1934 Bulletin, engineering data, description of Crystal Valve lightning protective equipment.—Electric Service Supplies Co., 17th & Cambria St., Philadelphia.

LOCOMOTIVES—Catalog 1994, all about Westinghouse diesel engines and fifteen standard sizes of diesel-electric locomotives.—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

(Continued on advertising page 70)

Instant Visibility Saves Money

For The Chicago Faucet Company Operating With McCaskey "One Writing" Methods

A portion of The Chicago Faucet Co., 3 Cabinet, 30 Board McCaskey System

ARE INVENTORY, PRODUCTION COST AND PAYROLL FIGURES VISIBLE IN YOUR PLANT?

Try yourself on answers to the six questions at the right. By use of McCaskey visibility of specially adapted forms in cabinets and control boards, The Chicago Faucet Company makes a saving of $3,500.00 to $5,000.00 a year according to H. E. Teichen, Treasurer. They answer these questions instantly with all records always up-to-date.

They control a large perpetual inventory of parts, another of assembled stock on hand, and follow every order visibly through all operations in production. Two full days are saved in making up the payroll over former methods.

The McCaskey type of perpetual inventory (Dual Control), production control, machine control and tool checking is so successful in maintaining control over costs and expenses in manufacturing plants in all industries that savings never believed possible are achieved.

Let us tell you how the answers to these questions are given you by McCaskey methods.

Write today to—

ANSWER THESE QUESTIONS:

1. **What is the amount of assembled stock on hand—item for item?**
2. **What is our raw material inventory — item for item?**
3. **Where is this order—and that—order for order?**
4. **How near completion is each — order for order?**
5. **How much will each cost—order for order?**
6. **What is the week's payroll — man for man?**

NRA MEMBER U.S. WE DO OUR PART

THE McCASKEY REGISTER CO., ALLIANCE, OHIO **INDUSTRIAL DIVISION 1074**

Galt, Canada **Watford, England**

McCASKEY ONE WRITING SYSTEMS

Solved!
DIFFICULT ADHESIVE PROBLEMS

Almost every factory has its adhesive problems—some large, some small. CASCO Glue, well known to America's woodworking industry, is now available in the form of a ready-for-use liquid which sets quickly, providing a strong bond . . . permanently flexible and waterproof . . . giving satisfaction on nine out of ten gluing jobs.

NEW! CASCO All-Purpose CEMENT

A general purpose liquid cement, combining in a water vehicle, the strength and adhesiveness of CASEIN with the waterproofness and flexibility of Rubber Latex. Ready for use; no heating; no volatile solvent; no fire risk.

CASCO ALL-PURPOSE CEMENT (No. 7715) combines permanently any two materials (metal, glass, rubber, wood, leather, fabric, etc.) providing one of the materials has sufficient porosity to permit escape of the water in the film of the cement. The bond is proof against heat, water, oil, alcohol, etc.

●

A Few of the Many Satisfactory Applications . . .

Cementing felt, fabric or leather to metal, such as lamp bases, ashtrays, etc.

Cementing floor coverings (linoleum, rubber, etc.) to wood, concrete, steel, etc.

As an erection cement, for bonding wall and ceiling coverings, and decorative or acoustic tile, fibre-boards, etc., to any surface, plaster, metal, wood or paint.

As a belt cement; and for general factory repairs.

As a general automobile cement for top repairs, window stripping, interior trim, etc.

●

TEST QUANTITIES FREE

We don't know the peculiarities of your gluing problem but we do have the hunch that CASCO ALL-PURPOSE CEMENT will do a better job for you. That is why we welcome requests for samples . . . so you can test CASCO under actual working conditions.

We will send, free from obligation, a full quart to any established company. Please advise:

1. *Materials to be cemented.* 2. *Approximate monthly use* (gallons) or One Gallon Can $2.00 F. O. B. Bainbridge, N. Y.

THE CASEIN MFG. CO. OF AMERICA INC.
350 Madison Ave., New York, N. Y.

No Strikes, No Lockouts

(Continued from editorial page 294)

•

vided, however, that in case of passage of legislation for a shorter work-week the work-week of Employees will be automatically decreased.

ARTICLE XI

It shall be the duty of the several Workmen's Committees hereinafter constituted to formulate a set of definitions covering recommended classifications of labor in various localities, such recommendations to be transmitted to the International Association for submission by the Association to the Employer for early conference between the two parties signatory hereto.

ARTICLE XII

Upon receipt of written request by any Employee the Employer shall cooperate with the Association in the collection of dues by deducting from the wages due said Employee each month the regular monthly dues as fixed by the Local Union where the Employer operates; and shall continue to make such deduction until receiving written instructions to the contrary from said Employee. All money so deducted by the Employer shall be paid as designated by the Employee on or before the 15th day of the month following that for which deductions are made.

ARTICLE XIII

An Employee shall not be discharged, if physically and mentally capable of continuing his duties, on account of any accident unless it appears that the accident was caused by the negligence, carelessness or malicious intent of the Employee.

ARTICLE XIV

It is agreed that any and all grievances pending on the date of the execution of this agreement shall be made the first order of business of the Local Workmen's Committee hereinafter provided for.

ARTICLE XV

This agreement shall in no wise affect the status of Employees on whose behalf it is made, with respect to benefits derived or to be derived by Employees as a whole from membership in any group insurance, stock purchasing plans or pension funds.

ARTICLE XVI

In cases where an Employee reports to his regular place of employment as instructed and then is instructed to report to any other place for work, transportation shall be supplied by the Employer or compensated for.

(Continued on page 50)

Dolph's

ELECTRICAL INSULATING QUARTETTE

Covers All Requirements for Maintenance and Repair

Dolph has taken the uncertainty out of the selection of insulating varnishes. Each member of the Quartette has been designed for a specific industrial maintenance need and can be depended upon to meet that need adequately.

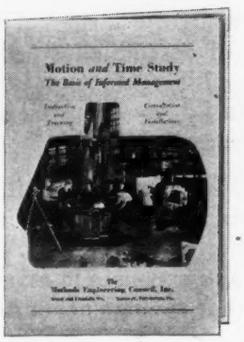
- **Dolph's Coil Black Air Drying—** for armature and coil insulation before assembling
- **Dolph's Black Finishing Varnish** Air dries in thirty minutes and is a waterproof black finish for meter boards, cables, feeders, etc.
- **Dolph's Electric Lacquer** the standard oilproof varnish and waterproof black finishing varnish for 25 years
- **Dolph's Red Oilproof Enamel** for use on mica cones and commutator ends to prevent trouble from oil creepage

Write for Descriptive Pamphlet

JOHN C. DOLPH CO.
Insulation Specialists
168 EMMET STREET
NEWARK . . . . N. J.

MOTION AND TIME STUDY TRAINING

AN EDUCATIONAL SERVICE THAT PAYS DIVIDENDS



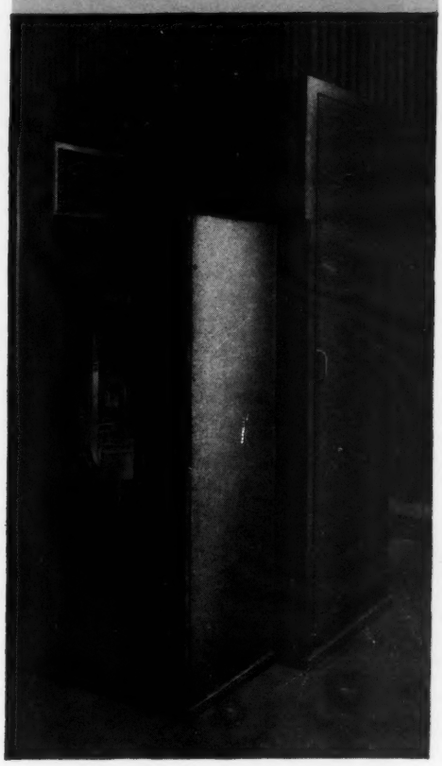
This booklet sent FREE on request.

THE instruction and training courses of the Methods Engineering Council are designed to satisfy the requirements of industrial organizations and of individuals seeking a thorough knowledge of advanced and authoritative motion and time study and training in its practical application. Send for booklet describing courses and training procedure.

METHODS ENGINEERING COUNCIL, INC.
Wood and Franklin Streets, Station 21
PITTSBURGH, PA.

HOW POWER-FACTOR IMPROVEMENT REDUCES POWER COSTS

SAVES $540 PER YEAR



SAVES $434 PER MONTH

THE Weber Flour Mills Company operated its 1600-barrel mill with one 200-hp. and one 300-hp. induction motor. On the advice of G-E flour-mill engineers, these two motors were replaced by one G-E 450-hp. Super Synchronous motor.

The plant power-factor was immediately raised to unity; and this, coupled with the increased efficiency of the new motor, has effected an average monthly power saving of $434.

THE Virginia Bridge and Iron Company, Birmingham, Alabama, installed a 60-kv-a. group of G-E Pyranol capacitors in 1933 with sufficient rack capacity to care for a future addition of another 60-kv-a. group. Power bills were immediately reduced by $45 a month.

Load increased and the additional 60-kv-a. group was installed in the rack in February, 1934. Monthly savings jumped to $70, which rate represented a 47% return on the investment. At this rate of return, the total investment will be written off in a little over two years.

GENERAL ELECTRIC

YOU TOO MAY SAVE

In hundreds of similar cases, the installation of G-E power-factor improvement equipment — capacitors, synchronous motors, synchronous condensers—has improved plant operation and effected savings. In those cases where power contracts included a penalty for low power-factor and a bonus for its improvement, substantial returns have been made on the investment. Look into these savings. Simply fill in and mail the attached coupon; or, if you prefer, call the G-E sales office nearest you.

GENERAL ELECTRIC COMPANY
Dept. 6 B-201, Schenectady, N. Y.

GET-541 ( ) GEA-77F ( )

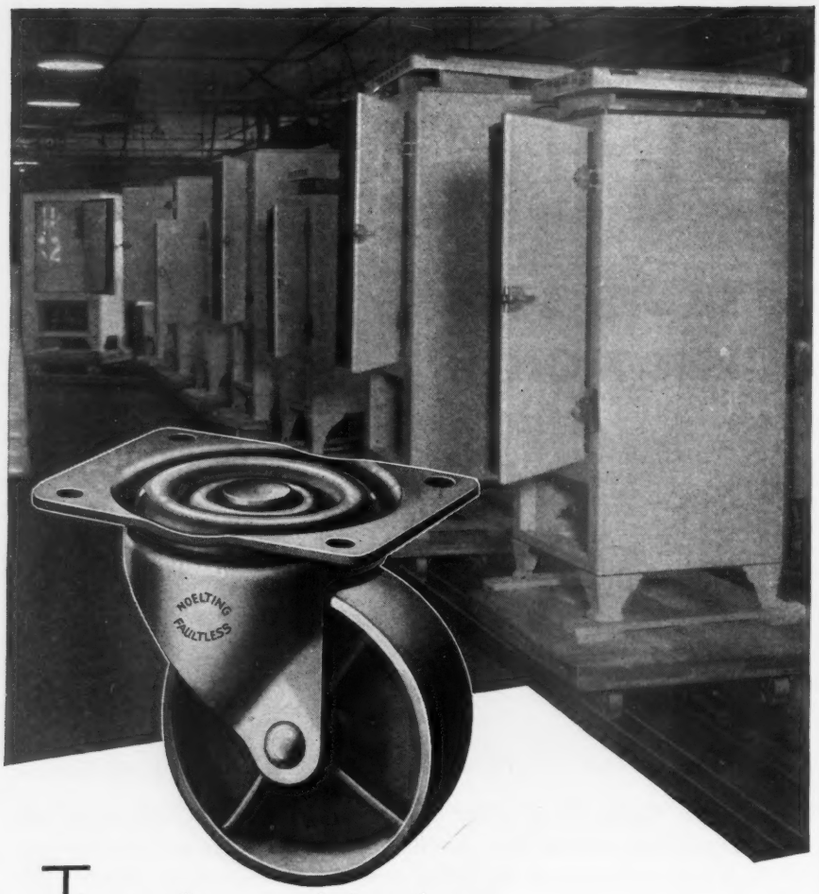
Please send me your bulletins "Direct-reading Power-factor Improvement Chart," GET-541, and "Improving Power-factor for Profit," GEA-77F, as checked above.

Name.....

Firm.....

Street.....

City..... State..... 060-2



This Assembly Line
at the Servel Plant moves on
FAULTLESS CASTERS

When production schedules demand that hundreds of Electrolux, Servel and Crusader refrigerators travel miles down the assembly line in a single shift . . . nothing can be left to chance. Servel takes no chances. Their production must be dependable. The assembly line pictured above moves smoothly, hour after hour, day after day, on Series No. 100 FAULTLESS Casters. Other assembly lines in the huge Servel plant are similarly equipped. The trucks that move costly air-conditioning equipment and heavy refrigeration units roll on FAULTLESS Heavy Duty Casters. Servel leaves nothing to chance.

The booklet, "Faultless Casters for Industry," provides interesting information on what good casters mean to maintenance of production schedules. Write for it.

NOELTING
FAULTLESS
CASTERS

EXECUTIVE OFFICES: EVANSVILLE, INDIANA

Branch Offices

Boston, Mass. · Buffalo, N. Y. · Grand Rapids, Mich. · High Point, N. C.
Los Angeles, Cal. · New York, N. Y. · St. Louis, Mo. · Stratford, Ont., Canada

ARTICLE XVII

The Employer shall cause a bulletin board to be placed on the property where it may be seen by Employees entering and leaving their place of employment. This board may be used by the Association for any matters pertaining to its membership in that place of employment.

ARTICLE XVIII

Inspection of all equipment throughout any plant or place of employment shall be made by the Superintendent or other person designated by the Employer from time to time, especially on pressure stills in refineries, in gas plants, in and around drilling equipment and other places where explosions, fires or industrial accidents are likely to result in a loss of life or injury to Employee. In refineries, an inspection of a still or other equipment may be secured upon the recommendation of the workmen employed on such equipment.

ARTICLE XIX

Employees shall be paid one and one-half (1½) times their regular rate in the event that they are called into conference with an Employer representative at any time other than their regular working hours.

ARTICLE XX

All Employees, upon completion of one (1) year of continuous service shall be entitled to one (1) week's vacation with full pay, based on full time weekly pay in the three months prior to vacation time. After completing two years' service Employees shall be entitled to two weeks' vacation, one week of which will be with full pay computed as above. After four (4) years' service Employees shall be entitled to two weeks' vacation with full pay computed as above. Any Employee laid off through reduction of forces or for any other reason beyond his control and re-employed within sixty (60) days shall be considered a regular Employee as regards vacation rights.

ARTICLE XXI

In exceptional cases where shift men are required to work for a longer time due to failure of relief men to appear, such overtime shall be paid for on the regular hourly basis of a day's wage. In other cases where overtime is required beyond established or regular hours of shift men, such overtime shall be compensated for on a time and one-half basis and the equivalent of the actual hours worked overtime shall be taken off.

ARTICLE XXII

Daylight Employees, when required to work on Sunday and holidays, such as New Year's Day, Decoration Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day, shall be paid at time and one-half. This does not apply to shift men.

ARTICLE XXIII

For the purpose of adjusting griev-

"WE ORDER EVERYTHING FOR OXWELDING AND CUTTING FROM LINDE"

Linde Process Service

• *Pinion gears, connecting links, reach blocks, pall levers and dipper teeth are shape-cut from strong alloy steels in routine operations. These dipper teeth are being accurately formed from alloy steel stock.*

WIDENS USEFULNESS OF OXY-ACETYLENE MACHINE CUTTING

RECENTLY a power shovel manufacturer reported how Linde Process Service helped perfect a series of complicated flame-cutting operations:

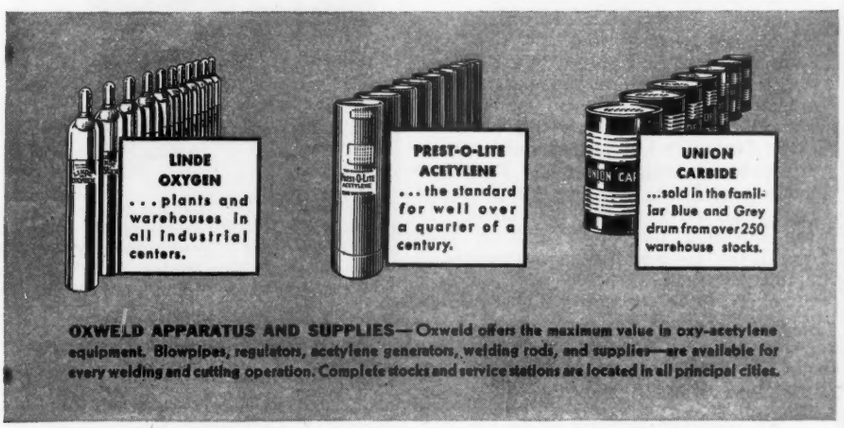
"We started to use oxy-acetylene shape-cutting several years ago—at first, only for dipper teeth. Later we used it on many other parts for which the strength of rolled or forged steel was desirable.

"On these parts oxy-acetylene cutting proved so profitable that we asked Linde to help us develop accurate shape-cutting of our heaviest parts from slabs and ingots.

"Linde Service Operators assisted in organizing this heavy cutting and advised on preheating procedures for special strong alloy steels. They supplied data on most efficient oxygen pressures, nozzle sizes, and cutting speeds.

"Now, we have replaced nine machines with two shape-cutting machines. We are cutting heavy steel to tolerances of 1/32-in. and less. We shape-cut parts accurately from steel 20 in. thick. Angle corners and curved cuts are simple for us."

By translating proved methods into terms of actual plant requirements Linde Process Service helped organize these shape-cutting operations for greatest speed, economy and dependability. It can probably help you in similar work. Ask the nearest Linde Sales Office to show you how.


LINDE OXYGEN
. . . plants and warehouses in all industrial centers.
PREST-O-LITE ACETYLENE
. . . the standard for well over a quarter of a century.
UNION CARBIDE
...sold in the familiar Blue and Grey drum from over 250 warehouse stocks.
OXWELD APPARATUS AND SUPPLIES—Oxweld offers the maximum value in oxy-acetylene equipment. Blowpipes, regulators, acetylene generators, welding rods, and supplies—are available for every welding and cutting operation. Complete stocks and service stations are located in all principal cities.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

126 Producing Plants UCC 627 Warehouse Stocks

IN CANADA, DOMINION OXYGEN CO., LTD., TORONTO

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES • UNION CARBIDE

PRODUCT OF A UNIT OF UCC UNION CARBIDE AND CARBON CORPORATION

Users of products and processes developed by Units of Union Carbide and Carbon Corporation benefit from a most unique coordination of scientific research with manufacturing, sales and service facilities. You are cordially invited to visit this summer the numerous exhibits sponsored by the Corporation in both the Basic and Applied Science sections in the Hall of Science at Chicago's 1934 A Century of Progress Exposition.

Sales Offices:

Atlanta	Houston	Portland, Ore.
Baltimore	Indianapolis	St. Louis
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Cleveland	New Orleans	
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NRA

HAVE YOU LEARNED THIS ABOUT SLINGS?

● Ask crane operators, engineers, plant superintendents who have had experience with braided slings what they think of them. They will tell you that braided slings give many times longer service than ordinary sling equipment. Time studies and performance records prove it.

Macwhyte braided slings (patented) are made of multiple parts of wire rope spliced endless and then braided. They are non-kinking, non-spinning, highly flexible. And they provide *positive safety.*

Write for catalog, complete data and performance records.

Macwhyte Company • Kenosha, Wisconsin

ADV. NO. 132

ances and disputes arising at any plant or within any region of operations, it is agreed that each individual Employee who is a member of the Association signatory hereto shall first seek direct adjustment of any grievance or dispute (not involving a construction of the terms of this agreement) with the foreman under whom he is employed. If such Employee fails to secure an adjustment, he may then submit his grievance to a committee, selected as hereinafter provided, for the particular plant or region in which such Employee is employed. Such committee, after investigation of the grievance, shall have the right to meet with the Company Superintendent or other official locally in charge, who shall receive the committee for this purpose. Written decisions shall be made by the Superintendent or other official within ten (10) days after the meeting with the committee.

In the event that the ruling or decision of the Superintendent or other official of the Company shall not be satisfactory to the Committee, it is agreed that the Chief Executive Officer of the Association shall have the right to confer with the Chairman of the Executive Committee of Consolidated Oil Corporation or someone designated by him, for the purpose of discussing the grievance or dispute and of obtaining a final decision thereon. Due consideration shall be given by the Executive Officer of the Employer and the Association and an effort shall be made to arrive at a fair and just decision. In the event of the failure of these two Executives to reach agreement the procedure prescribed in the last paragraph of this section shall be followed.

The Committee above mentioned shall be selected from among and by Employees of the Employer who are members of the Association. In order to be eligible for membership on any such committee, an Employee must be an American citizen, and must have been actually engaged in the oil industry for one (1) year next preceding his election. No official, foreman, subforeman, straw boss, gang pusher or Employee having authority to hire or discharge men shall serve on the committee. In the selection of the committee, each Employee to whom this agreement is applicable shall have one vote for each member of the committee to be elected.

In case of discharge or layoff, Employees (members of the Association) who may desire to file complaints must present such complaints within one (1) week after the date of discharge or layoff to the committee mentioned in this Article. When any such Employee is discharged or laid off, he shall be given a written notice, dated and signed by his foreman or other representative of the Employer, setting forth the reason for such discharge or layoff.

In the event any dispute or disagreement arises as to wages or changes in wages which is of a general character or which affects a large number of Employees of any one of the Employers to which this agreement is applicable, such dispute shall be referred for settlement to the Chief Executive of the Employer

DUST ~an Industrial Expense

Put DUST on the list of "Expense Items" to be eliminated in your plant! Frequently unaware of the extent to which dust is a menace, industrial management pays a heavy price for tolerating it. Set your plant free from this annoyance and expense.

Methods of Elimination

Where cleaning, buffing, grinding or similar process is the primary cause of dust, a simple system of hoods with an efficient exhaust fan will remove this dust at the source. Buffalo Mill Exhausters are particularly suitable for this kind of service. Where due to the nature of the product or process dust is present all thru the plant, a central ventilating system in connection with a Buffalo Air Washer will give excellent results.

Exhaust Fans

Buffalo Mill Exhausters are made in Standard and Slow Speed types; other exhaust fans include Volume Fans, cast-iron construction; and BREEZO Electric Disk Fans. Full details on all these exhausters will be sent on request.

Air Washers Buffalo Air Washers are well known all over the world for high air-cleaning efficiency. Every cubic foot of air which passes thru a Buffalo Air Washer is actually WASHED with water, so that dirt and dust is removed.

Buffalo Forge Company
171 Mortimer St., Buffalo, N. Y.

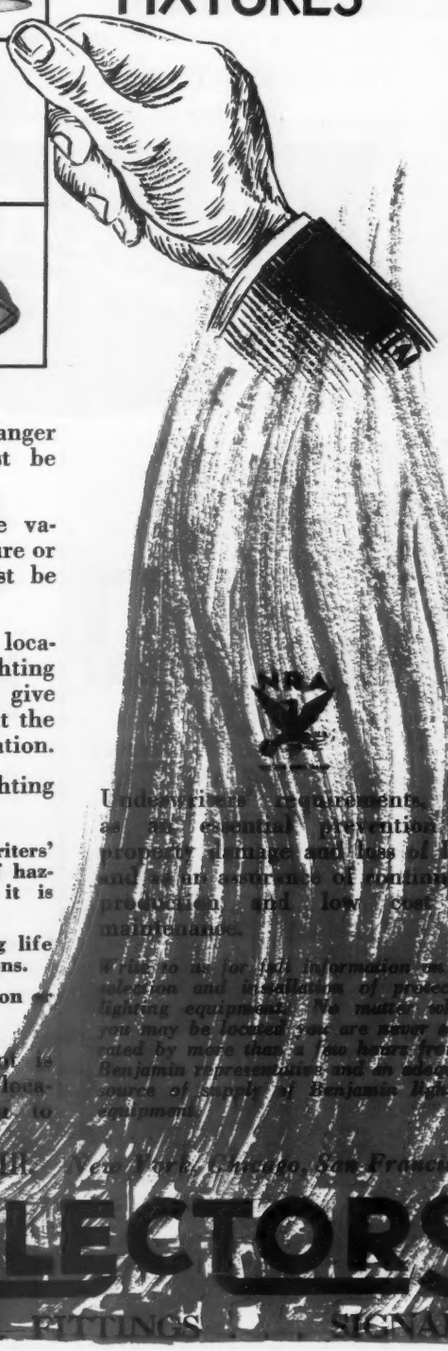
In Canada: Canadian Blower & Forge Co. Ltd., Kitchener, Ont.

"Buffalo" for DUST Elimination

When your lighting equipment is exposed to these hazards . . . .

Atmospheres containing vapors of gasoline, common petroleum, ethyl alcohol, methyl alcohol, acetone and lacquer solvents.	Benjamin Explosion-Proof Lighting Fixtures	
Atmospheres containing steam, moisture, corrosive vapors and other exposed locations.	Benjamin Vapor-Proof Lighting Fixtures	
Atmospheres containing combustible dust and easily ignitable materials producing flammable flyings.	Benjamin Dust-Tight and Moisture-Proof Fixtures	
Dirty and dusty locations where reflectors and lamps must be protected.	Benjamin Dust-Tight Glass Covers and Guards	

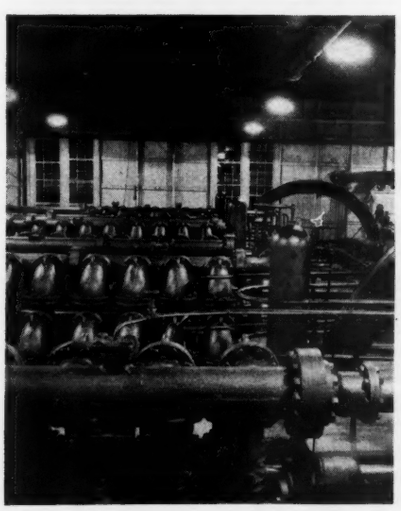
Specify BENJAMIN PROTECTIVE LIGHTING FIXTURES



In most industrial plants, in railroad terminals and shops, in paint and varnish factories, in powder mills, in grain and cereal mills, fertilizer factories, etc., there are hazardous locations where protective lighting equipment, especially designed to minimize the danger of fire and explosion, must be installed.

In other locations, corrosive vapors, steam, fumes and moisture or excessive dust and dirt must be guarded against.

For all of these hazardous locations, there is a Benjamin lighting fixture specially designed to give dependable protection and, at the same time, adequate illumination.



Benjamin Protective Lighting Equipment is

- **Listed as standard by Underwriters' Laboratories for the group of hazardous locations for which it is designed.**
- **Ruggedly constructed for long life under severe service conditions.**
- **Easily taken down for inspection or cleaning.**

Protective lighting equipment is necessary in these hazardous locations, not only to conform to Underwriters' requirements, but as an essential prevention of property damage and loss of life, and as an assurance of continuous production and low cost of maintenance.

Write to us for full information as to selection and installation of protective lighting equipment. No matter where you may be located, we are never separated by more than a few hours from a Benjamin representative, and in addition a source of supply of Benjamin lighting equipment.

BENJAMIN ELECTRIC MFG. CO., Des Plaines, Ill. *New York, Chicago, San Francisco*

BENJAMIN TRADE MARK REFLECTORS

FLOODLIGHTS . . . PANELBOARDS . . . FITTINGS . . . SIGNALS

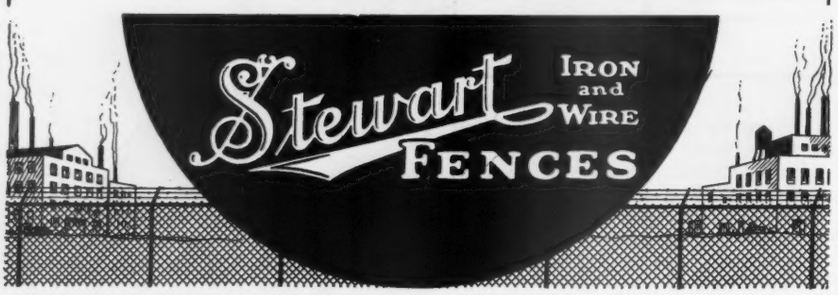
install
FENCE

STOP TRESPASSING!

Stewart-Non-climbable Chain Link Wire Fence says "stay out" —and means it! Trouble-makers lose their entree when Fence is installed. Stewart Fences are of copper-bearing steel Fabric, galvanized AFTER WOVEN. Available with tubular or heavier open section I-Beam framework—galvanized after fabrication.

Let us quote on your requirements.

The STEWART IRON WORKS COMPANY, *Inc.*
209 Stewart Block — Cincinnati, Ohio



PYROIL
(Simply Add to Regular Oil)
CUTS *maintenance* COSTS

Pyroil is the latest scientific achievement in lubrication. Simply *added* by the ounce to the regular oil and grease, it cuts friction, overheating, wear and damage because it sheaths all frictional metal with a heat-proof, wear-resisting surface of protection, which constantly renews itself. Actually *makes metal self-lubricating.* Cuts operation costs.

Mail coupon for a FREE COPY of new Pyroil Industrial Brochure, illustrating, classifying and tabulating many important Pyroil facts and uses.

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415 LaFollette Ave., LaCrosse, Wis., U.S.A.
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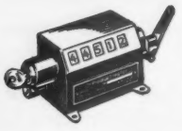
Check and Recheck

A sizable part of factory overhead is in the costs of checking and rechecking production and piece work wages.

Productimeters **(mechanical counters) on machines and conveyors eliminate hand counting, supply accurate records instantly, and greatly simplify and reduce clerical work.**

There is a *Productimeter* for almost any type of production machine or conveyor. Send for our catalog *Productimeters.*



DURANT MFG. CO.
1918 N. Buffum St.
Milwaukee, Wis.

Productimeters
THE SPEEDOMETERS OF INDUSTRY

by whom the Employee is employed and the Chief Executive of the Association. In the event they are unable to agree upon terms of settlement of such dispute, the same shall be referred by the Employer to the Chairman of the Executive Committee of Consolidated Oil Corporation or someone designated by him, and by the Association to the Chief Executive of the American Federation of Labor and if they shall be unable to agree upon terms of settlement of such dispute they shall agree upon a method and procedure of arbitration for the settlement of such dispute or grievance. The award of such arbitration to be binding upon the Association and the Employees it represents and the Employer.

ARTICLE XXIV

Nothing herein shall be construed as applying to or binding upon any Employee of either of the Employers who are not members of the Association.

ARTICLE XXV

The term "shift men" as used herein shall be deemed to mean men who are employed for specified periods in the course of continuous operations carried on twenty-four hours per day.

The word "job" means the operation or classification of work performed.

ARTICLE XXVI

If any court shall hold any part of this agreement invalid, such decision shall no invalidate the entire agreement.

Questions and Answers

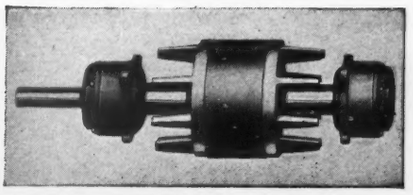
(Continued from editorial page 334)

no-load voltage; then load the generator to its rated capacity and without changing the rheostat setting adjust the series field shunt until the desired full-load voltage is obtained. Shut this generator down and make the same adjustments on the other one. Now open the series field circuit of each generator and insert an ammeter in each at a point where only the current that actually flows through the series field will be measured. Put both machines on the board and load to full capacity, dividing the load evenly. Read the meters and insert enough resistance in the series field circuit of the machine having the higher reading to make the two equal. This resistance should be left permanently in the circuit.

ROY M. STINSON, *Operating Engineer Rock Island Lines, Chicago*

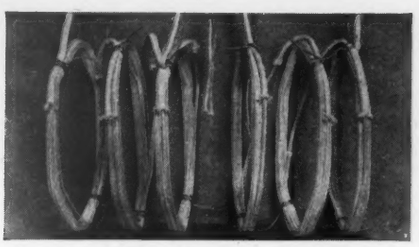
SUCH troubles were common in the past, before the features of generator design were so thoroughly understood as they are now.

The fact that the machines are flat-

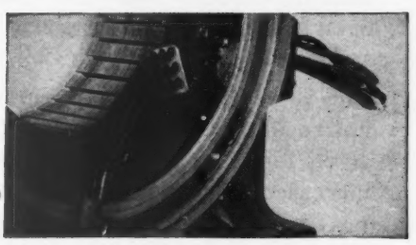


Complete rotor assembly with cartridge-type sealed ball bearings. Note rotor winding is of one-piece construction.

Lubricate sealed ball bearings once a year with tube contained lubricant. Bearings, dust tight. No lubrication drip.

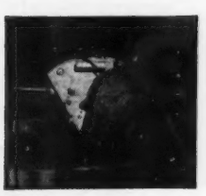


Group wound coils—an entire phase group in a single piece of wire—lead connections from each group *welded*, not soldered or brazed.



Sealed-in leads through frame opening—anchored permanently. No chance for strain on field leads.

Slot insulation—self locking by means of cuff construction — permanent and additional protection for field windings.



Final vibrometer test —one of a series to insure a smooth running motor with minimum vibration.

• • • you get more features with F-M Motors

Fairbanks-Morse pioneered many of the standards of the present day motor building industry.

Today the pioneering skill goes on — pioneering to create the standards of the industry of tomorrow.

But F-M pioneering is an *exacting* pioneering! It is a developed method of building motors better *mechanically* — building them better to serve you longer at lower maintenance expense.

These motors meet the most exacting electrical specifications. But with characteristic thoroughness, Fairbanks-Morse has achieved a position of leadership in *mechanical* construction.

Fairbanks-Morse pioneered *mechanical excellence* in electric motors. It pioneered *ball bearings, grease tube lubrication, one-piece rotor construction.*

Pioneers in motor building progress, Fairbanks-Morse asks only an investigation of how much *more* these motors have to offer. Start your investigation by writing for full information. Address Fairbanks-Morse & Co., 900 S. Wabash Avenue, Chicago, Ill.

Pioneer Designers and Manufacturers of POWER, PUMPING AND WEIGHING EQUIPMENT 104 Years

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MOTORS

6094-EA-40.62

When you insist upon seeing the famous GE monogram on every lamp you buy, you are receiving the benefits of more than 100 major improvements which have been made in General Electric MAZDA lamps through research and development work.

The value of these improvements, in the past ten years alone, has resulted in a truly startling increase in the amount of light given for the current consumed. In dollars, the value of this increased efficiency was more than one billion dollars.

But users of General Electric MAZDA lamps have not been compelled to pay a premium for a constantly improved product. On the contrary, General Electric MAZDA lamps of today are approximately 58% lower in price than they were in 1921.

In addition to good light at low cost, General Electric also offers a corps of trained experts whose services are available at no cost, to let executives "see for themselves" the actual lighting condition of their plant or store.★ Simply write to General Electric Company, Nela Park, Cleveland, Ohio.

★ *This meter measures light as accurately as a thermometer measures temperature. It tells you the amount of light you now have, and indicates the amount of light you need. It lets you "see for yourself."*

GENERAL ELECTRIC
MAZDA LAMPS

compounded is no definite assurance that at all points between no-load and full load the voltage curves of the two are the same. To obtain these curves it will be necessary to impose on each machine some artificial load, which may be a dead resistance in the form of a group of grids, or two or more water rheostats. The voltage should be adjusted at no-load and the units then loaded to capacity or, better, to 125 or 150 per cent of capacity. For each setting readings of volts and amperes should be taken. The results can be plotted on cross-section paper, with volts as the ordinate and amperes as abscissa. Curves obtained in this way will indicate at once whether they cross at intermediate points, or whether one is much different from the other. My experience has been that no trouble is encountered with units that operate within 2 per cent voltage difference.

A second factor is the variation of the airgap of the interpoles. The manufacturer will advise what it should be, and it can easily be checked with a tapered gage, which can be made or purchased. The adjustment of the gaps by adding or taking out shims under the interpoles is a simple matter and may improve results if the bearings are not worn too much.

Assuming that all connections are correct and well made the adjustment of the interpole shunt, if there is one, or the addition of one, will make it possible to reshape the compounding curve. If a shunt is used it should be of the inductive type; that is, wound over a laminated iron core.

A possible remedy which may be used temporarily, pending final correction, would be to connect the shunt field of one unit to the armature of the other, when the two are operating in parallel. A rise in voltage of one unit will immediately raise the voltage of the other unit and force it to take more load. A two-pole, double-throw switch will change the field to suit operating conditions.

C. O. VON DANNENBERG, *Brooklyn, N. Y.*

Does It Pay to Overbelt?

I presume that using a heavier belt than is required according to belting tables to carry a given load will result in longer life and possibly better service, but I should like to know whether in general these advantages are sufficiently marked to justify the extra cost. For example, a table which I use recommends a 7-in., light-double leather belt on a 20-hp., 1,200 r.p.m. drive, with a 9-in. diameter motor pulley. Assuming that this is an ordinary drive, with no unusual load conditions, would there be any justification for using a wider or thicker belt? Conversely, would there likely be marked shortening of life or more trouble if a belt say

"Discard ALL old standards of BELT DRIVE PERFORMANCE"

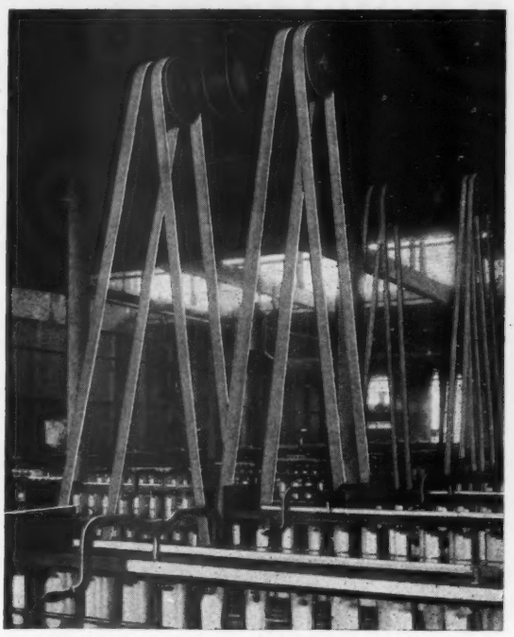
GRATON AND KNIGHT

Graton & Knight Engineers have produced a flat leather belt as far in advance of previously accepted standards as modern group drive is in advance of the old line shaft drive.

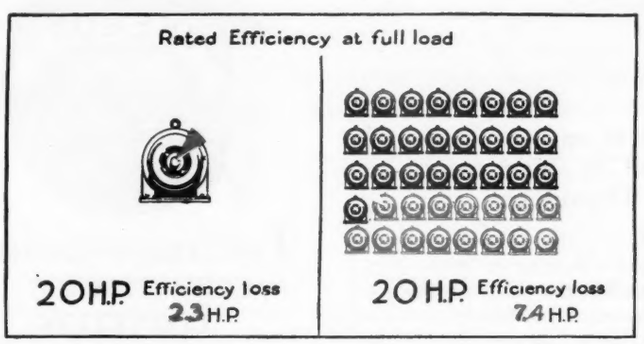
This New Research Belting consistently requires but one take up to 3 or 4 for old type leather belting. It delivers full power from the day of installation, with only normal tension and bearing pressures. Modern group drives, short center drives, individual machine drives . . . Research Belted . . . require less maintenance. Machine speeds and production are consistently maintained at peak.

A combination of scientifically balanced improvements—low stretch factor—high co-efficient of friction, natural flexibility and greater strength have made G & K Research today's most economical belting.

Profitable plant operation demands analysis of every machine drive on a basis of actual costs and possible savings. While the cost of belting itself is but a small item, the results of this important advance in belt making promise very substantial reductions in your unit production costs. We will welcome an opportunity to show you performance data covering the operation of the New Research Flat Leather Belt Drives in representative plants throughout Industry. Write Graton & Knight Company, Worcester, Mass.



HIGHLIGHTS of the MODERN GROUP DRIVE



LARGER H.P. packages give you more for your money

This chart shows the efficiency losses in large and small motors of the same total horsepower, according to standard motor rating tables.

There are some drives in every plant where the advantages of the individual motor installation make these losses of slight importance. But where many machine units maintain steady production, the greater motor efficiency of Modern Group Drive represents a substantial saving.

This chart is taken from a booklet published by the Mechanical Power Engineering Associates, and giving in simple, non-technical form the results of a two-year study of modern group and unit drive systems in Industry. **We will be glad to send you a copy on request. Write us.**

Check your own operating experience against these RESEARCH PERFORMANCE FACTS...

Research belting, installed as a test on one of the 15 hp. fan drives in a series of cooling towers, proved so satisfactory that the other drives were at once similarly equipped. None of the belts has yet been shortened *after from two to three months continuous operation.*

●

After *a year and a half* of continuous operation on a short center 15 hp. vacuum pump drive, a 5″ Research Belt in a tire company's plant shows only 2″ stretch. Previous belt life on this installation was from *2½ to 3 months.*

●

In a Philadelphia paper mill, the 28″ Research belt on the turbine drive to a paper machine was shortened only 4″ (.06%) about a week after installation. At the end of three months continuous operation this belt showed no further stretch. Horsepower of turbine, 260 with 25% overload capacity. Driving pulley 26″ x 30″ face; driven pulley 33″ x 30″ face; centers 23′ x 1″, 40° angle, tight side on bottom. Turbine speed 176 to 716 r.p.m.

●

A St. Louis shoe company has some interesting Research belted, fixed, short center blower drives, which have been in operation over two years with highly satisfactory results. Centers are 20″, the belts 3″ singles driving vertically from 3 hp. motors, 1750 r.p.m. with 4″ driving pulleys and 12″ blower pulleys. What little stretch has taken place has been easily compensated for by adjustment of the motors without removing the belts.

NRA

GRATON & KNIGHT *Research* LEATHER BELTING

GRATON & KNIGHT COMPANY . . . . . WORCESTER, MASS

Air Conditioning ENGINEERED TO THE JOB

Our Price May Not Be the Lowest

But Believe Us You'll Get Results

CLARAGE operates somewhat differently from most air conditioning manufacturers. We offer no so-called "standard" systems—no "blanket" equipment covering all needs.

Instead we treat each air conditioning job—small or large—as an individual engineering problem. And in every case, after requirements are established, a Clarage System is **built specially** to meet those requirements—**to meet them exactly.**

THE PIONEER

For more than two decades Clarage has been a leading producer of air conditioning equipment—a pioneer—an organization of experts. Our installations are many and invariably successful.

We air condition industrial plants, stores, theatres, restaurants, fine homes, etc. We have facilities for handling all types of temperature and humidity control.

If you have an air conditioning or cooling problem, very decidedly will it pay you to consult with us! For immediate action on our part, use coupon below.

MAIL THIS COUPON

CLARAGE FAN COMPANY
Kalamazoo, Michigan
Without obligation, have a Clarage engineer call to discuss air conditioning.

Name .....
Company .....
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CLARAGE
AIR HANDLING AND CONDITIONING EQUIPMENT

1 in. narrower than called for were used? How much factor of safety is allowed in the belt tables put out by the different manufacturers?
C.S.G.—Atlanta, Ga.

IT IS seldom a mistake to use a wider belt than the tables prepared by leather belting manufacturers indicate.

A belt 8 inches wide used on the drive mentioned would cost less than 15 per cent more than the 7-inch belt, but it would give at least 25 per cent longer life. On the other hand, a 6-inch belt might be used here since it would undoubtedly handle the load, but the saving in first cost would be more than offset by the shorter belt life and the greater frequency of belt take-up.

The standard N.E.M.A. pulley for a 20-hp,. 1,200-r.p.m. motor will take only a 7-inch belt. Whether putting on a wider belt will cause excessive bearing strain is a feature that should be considered. An 8-inch belt on this drive will transmit the load with less tension than a 7-inch belt, but it is possible to put more tension on the 8-inch belt and unless the motor bearings are of adequate size there might be trouble.

Personally, I would prefer to put a 10-inch-diameter pulley on the motor, with whatever size of driven pulley would be required, and run the belt at the resulting higher speed. This combination would mean less belt tension and longer life, and a better drive would be obtained from the 7-inch belt.

It would not be advisable to use a heavier belt on C.S.G.'s drive because of the small diameter of the motor pulley.

W. L. WOMACK
Engineering Department
S. R. Sikes Company, Minneapolis

Comment on Instruments Needed by Maintenance Department

IN THE May issue, page 58, Lee F. Dann listed a number of instruments that are needed in the electrical maintenance department. In addition to those given in his list, I suggest the following:

Test board for testing fuses, lamps, motors, and controls for a.c. and d.c. machines.

One Wigginton voltage tester for each electrician—used in testing fuses and circuits outside the electric shop.

One magneto for locating shorts, grounds, and opens in wiring and apparatus, and checking new wiring jobs.

One compass, of the Boy Scout type, for checking pole-phase groups in a.c. machines and poles in d.c. motors.

One ohmmeter for measuring the resistance of holding coils, shunt field coils, resistors, and so on.

Ground detectors on both a.c. and d.c. systems.

Airgap gages.

CLARENCE W. HOPE, *Lowell, Mass.*

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DILECTO
MICABOND
STANDARD FORMS OR SPECIAL PARTS

INSULATION

A HIGHLY SPECIALIZED COMPLETE SERVICE plus DESIGNING AND ENGINEERING ASSISTANCE

CONTINENTAL-DIAMOND FIBRE COMPANY
NEWARK, DELAWARE
CHICAGO
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VEELOS
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BELTING

For TRANSMISSION
ELEVATING
CONVEYING

Grip
Has a grip that won't slip
Power
Transmits full power without loss
Stretch
Neither stretches nor shrinks
Protection
Waterproof and steamproof
Variance
Unaffected by atmospheric changes
Uniformity
Uniform in texture and thickness
Precision
Runs true and smooth on pulleys

MANHEIM MANUFACTURING AND BELTING CO.
Main Office and Factory: Manheim, Pa.
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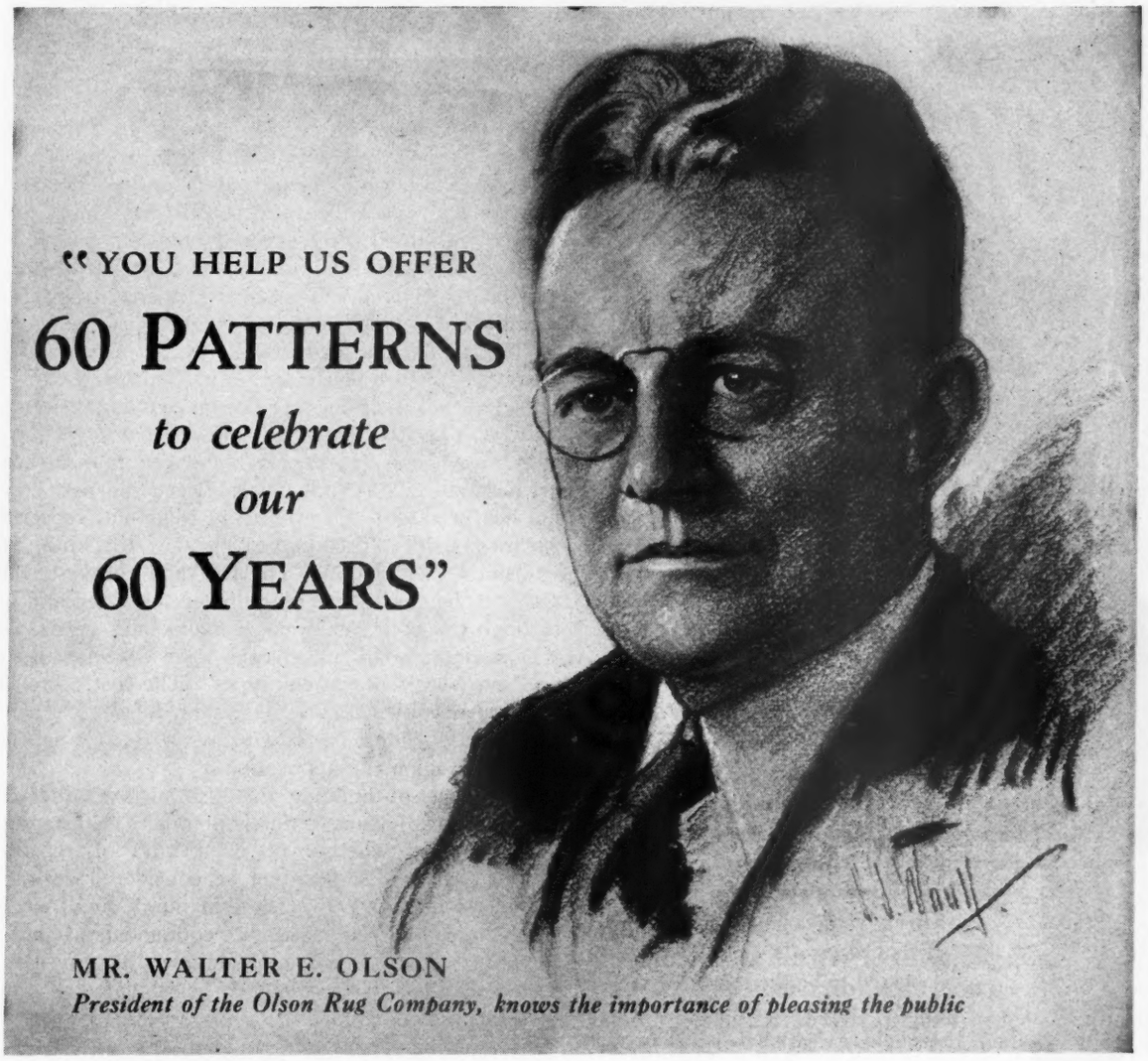

MR. WALTER E. OLSON
President of the Olson Rug Company, knows the importance of pleasing the public

"FOR 60 years the women of America have been sending us their old carpets, rugs and clothing to be re-dyed and re-woven into new rugs. And today we are the largest manufacturers of rugs in America dealing direct with the home.

"This year, celebrating our 60th anniversary, we are offering 60 new colors and patterns, thanks in large part to Monel Metal.

"Our dyehouse is one of the finest and most modern in this country. Monel equipment enables us to re-dye all sorts of reclaimed wool in brand new colors, and do it *promptly*.

"Because our dye equipment is Monel Metal it is quickly cleaned between batches (dye one tint—clean—dye another tint—then clean again.) Monel Metal does not, *can not*, soak up dye. Can't absorb it. Just a quick rinse, and it's ready for the new color.

"Moreover, Monel Metal does not *react* with the dye liquor. Doesn't set up chemical action to produce 'off colors.' It helps us to give our customers the color they want, always true to sample, and without delay."

✲ ✲ ✲

Monel Metal qualities that are valuable in the dyehouse, are equally valuable to other manufacturers who need equipment that is chemically stable, resistant to corrosion, and immune to rust. Only Monel Metal combines these properties with the tremendous strength demanded for its use as stems and seats in the monster valves of Boulder Dam.

The laundry owner, the food processor, the salt maker, in common with the power plant engineer, the hospital superintendent, the hotel manager, the maker of drugs and chemicals, all depend on Monel Metal to cut their costs of maintenance and operation.

Get the facts! Then decide how Monel Metal will pay its way as equipment for your factory, or in your product to increase its sales appeal. Ask our engineers to lay their data before you. Only in that way can you reach the kind of decision that you want to make.

See the INCO *Exhibit of*
MONEL METAL Household Appliances
at A Century of Progress, Chicago—1934
Home Planning Hall

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall St., New York, N. Y.

Monel Metal is a registered trademark applied to an alloy containing approximately two-thirds Nickel and one-third copper. Monel Metal is mined, smelted, refined, rolled and marketed solely by International Nickel.

Monel Metal

Thor

ROTARY BRUSH WITH THE CORRECT SPEED FOR *Efficient Operation*

● Selection of the correct speed is of primary importance to the efficient operation of a Rotary Brush—Realizing this, Thor Engineers experimented extensively with various speeds on many different materials—1400 R.P.M. was discovered to be the most satisfactory speed. At this speed the brush cleans thoroughly, wears evenly, lasts much longer, and the danger of flying wires is eliminated.

The Thor 256-G can be furnished with either Grip Throttle or Straight Throttle. Weight only 10 pounds. Ball bearing throughout.

THOR 260-S ROTARY SANDER

Handles set at 90° angles allow greater ease in handling, and permits more accurate work, than the ordinary Straight Throttle type. Weight 10 lbs. Used for sanding, polishing, and buffing.

Write for Catalog No. 19

TOOL MAKERS SINCE 1893

INDEPENDENT PNEUMATIC TOOL CO.

604 W. JACKSON BLVD., CHICAGO, ILL.

Put Buildings in Shape

(Continued from editorial page 326)

•

The third item, deterioration due to use or wear and tear is the most costly and difficult of correction. The original planning of a building is highly important from this point of view because at this time much of the trouble and cost of repairs and renewals can be either eliminated or greatly lessened, with proportionate savings. Greatest renewal costs are usually for parts subject to damage by wear, which includes floors, stairs, ramps, loading platforms, and the like. Parts of these areas are almost constantly subjected to walking and trucking, and their life varies greatly with their use.

It is almost universally known that steel or iron wheels used on trucks and other equipment are the greatest enemies of any floor. Even the best concrete finishes produced will eventually wear out, especially in trucking aisles. Wood, regardless of the kind, cannot withstand their action. The best and cheapest solution seems to be steel plates placed over the wood and bolted through the floor, using countersunk bolt heads. There are available solid-rubber-tired steel wheels, and composition wheels of various types. The cost of renewing them is usually cheaper than floor repairs. Their use so far has in most cases proved satisfactory depending, of course, upon the application.

Inspection of building interiors involves the careful examination of many different items, to determine their condition and whether or what kind of repairs are needed. It may or may not be considered desirable to include in this inspection some of the items of electrical, mechanical, and general service equipment that are commonly found in industrial buildings. In any case, the results of the inspection should be tabulated as a matter of clearness and permanent record. A convenient form for recording the results of inspections was shown in the preceding article. With some modifications this form can be made to serve equally well for interior inspections. The table on page 326 shows some of the more important items of the building structure that should be inspected, with the nature of the most likely defects and/or the kind of maintenance attention needed.

To Estimate Wiring Costs

(Continued from editorial page 328)

•

labor, both when installing the snake and pulling the wire. In the latter case, one man will be required to guide the wire through the box.

Although the number of man-hours per unit of length is a suitable way of determining or expressing the time element, the number of man-hours per run is in most cases much easier to visualize.

Last comes the connection of the equipment. This usually involves the soldering of lugs, although with the

ROOF FOR YEARS TO COME *with*

REG. U.S. PAT. OFF.
TONCAN
COPPER MO·LYB·DEN·UM IRON

At top—Fourteen tons of corrugated Toncan Iron Sheets used on the roof of storage shed for L. D. Smith, Inc., Lemoyne, Pa. Installed by H. B. Alexander, Harrisburg, Pa. Architects: Whitman & Royer, York, Pa.

NEW PLANTS facing the roofing problem for the first time, and old plants confronted with the necessity of re-roofing, should know the facts about Toncan Iron—the sheet metal roofing that for 25 years has been earning profits for plant owners.

Toncan Iron is an alloy of refined iron, copper and molybdenum. Within itself it holds the highest qualities of rust-resistance, ranking first in this respect among the ferrous metals, after the stainless alloys. Galvanizing and paint give additional protection and make for a degree of permanence that will prove a revelation to users whose only experience in the past has been with unalloyed sheets.

Evidence—yes, plenty of it. The Paine Lumber Co., Oshkosh, Wis., covered their buildings with Toncan Iron in 1909 and today they are still in good condition. The New York Dock Co. covered four piers with Toncan Iron in 1916 and they are still good for many more years.

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small wires it may be necessary only to shape and place them under clips. At control devices it may be necessary to test and tag the wires, although this can be eliminated by the use of color-coded wires. Even in a simple installation of alternating-current motors use of a separate color for each phase wire will save time. Besides the connections to apparatus, there may be splices or taps in junction boxes, which will require labor. When all connections have been completed time will be required to tape the connectors at each motor. Also asbestos taping or sleeving may be required, as in pull boxes or troughs or at the connections to resistors for drum control equipment. The table (page 328) indicates a fair amount of time which may be allotted to each of these items.

The Final Figures

Total man-hours multiplied by the hourly rate will give the total cost of material and labor, exclusive of supervision and administrative expenses. Cost of supervision varies with the number of electricians in the plant and the amount of labor involved on the job in question. Thus, if only one electrician and a helper are employed no supervision is directly chargeable. With a large force the time that the chief electrician or a foreman devotes to the job is directly chargeable. Administrative expenses, such as purchasing, are a part of the general overhead and may or may not be charged to the job, depending on the accounting system used.

A charge for inspection is usually made by the Fire Underwriters or other insurance organization. A charge may or may not be made by municipal or other authorities having jurisdiction over this work. In many states compensation and/or liability insurance is obligatory; therefore, such charges should also be added to the cost estimate.

Although this discussion has been confined primarily to wiring for motors, the same procedure may be followed in preparing cost estimates for lighting systems. Some of the items involved in wiring for such systems are listed in the table. However, in view of the different methods of installing lighting systems, no attempt has been made to cover this work in detail.

Motor and Control Problems

(Continued from editorial page 321)

allows it to return to its normal position. Figure 2 shows a Thrustor unit operating a gate in a cotton distributor.

Some varying-speed drives require an adjustable-speed motor whose speed is not greatly affected by changes in load. With a wound-rotor induction motor a 50 per cent decrease in speed at full load can be obtained by inserting resistance in the secondary circuit. However, a decrease or increase of 50 per cent in load will result in a corresponding increase or decrease of 50 per cent in speed.

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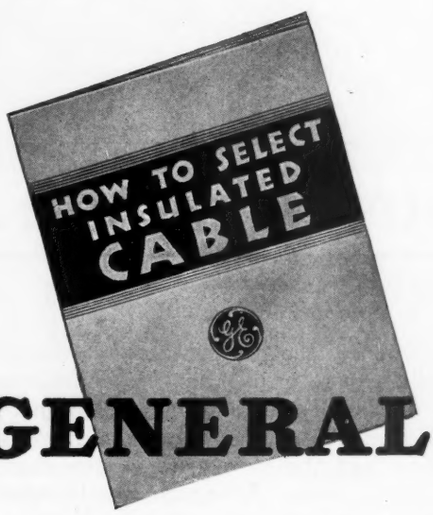

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In the event that this publication does not give you all the information which you require, we offer the assistance of our cable engineers and specialists—men who have had wide experience in the application and installation of all types of insulated cable. To obtain their services, simply address a request to the nearest G-E sales office.

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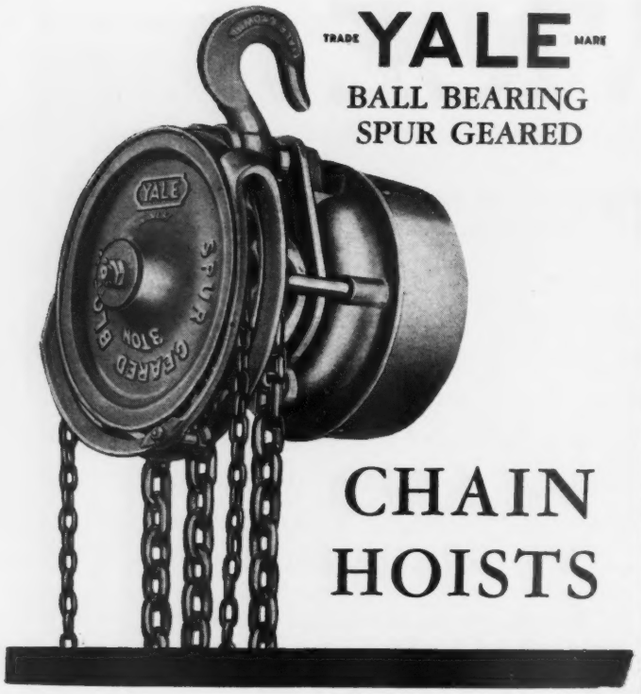

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alternating-current motor that will not be materially affected by changes in load, the adjustable-speed, brush-shifting motor should be considered. This type of motor has speed-torque characteristics comparable to those of a direct-current, shunt-wound motor. Automatic speed control can be obtained on certain drives where an operating lever is used to change the brush position.

Use of a brush-shifting motor, Figure 3, proved to be the solution of the problem of properly driving a pulverized coal conveyor in one plant.

A new plant installed 29 continuously running belt conveyors that required driving motors varying from 5- to 40-hp. rating. The speed of the conveyor headshafts ranged from 17 to 93 r.p.m.—and space was limited.

Motors with inbuilt speed-reduction units whose output speeds permitted them to be coupled directly to the conveyor headshafts met all of the requirements in this case.

One of the highly desirable characteristics of geared motor-reducers is their compactness, which results in saving of space and simplifies installation.

In order to save space and cost the motor of such units usually has a speed of approximately 1,800 r.p.m. In induction motors this design results in a higher efficiency and power factor than if a slow-speed motor were used. For example, a 25-hp. squirrel-cage induction motor such as is used in a geared motor-reducer unit has an efficiency of about 89.5 per cent and a power factor of 91 per cent at full load. A 25-hp. motor operating at one-third of this speed will have a full-load efficiency of about 87.5 per cent and a power factor of 78 per cent. A geared motor-reducer unit with a high-speed motor can, therefore, be designed to have a much lower speed of the output shaft than is practicable for any induction motor rotor, but at the same time retain the important advantages of high efficiency and power factor.

What About Diesels?

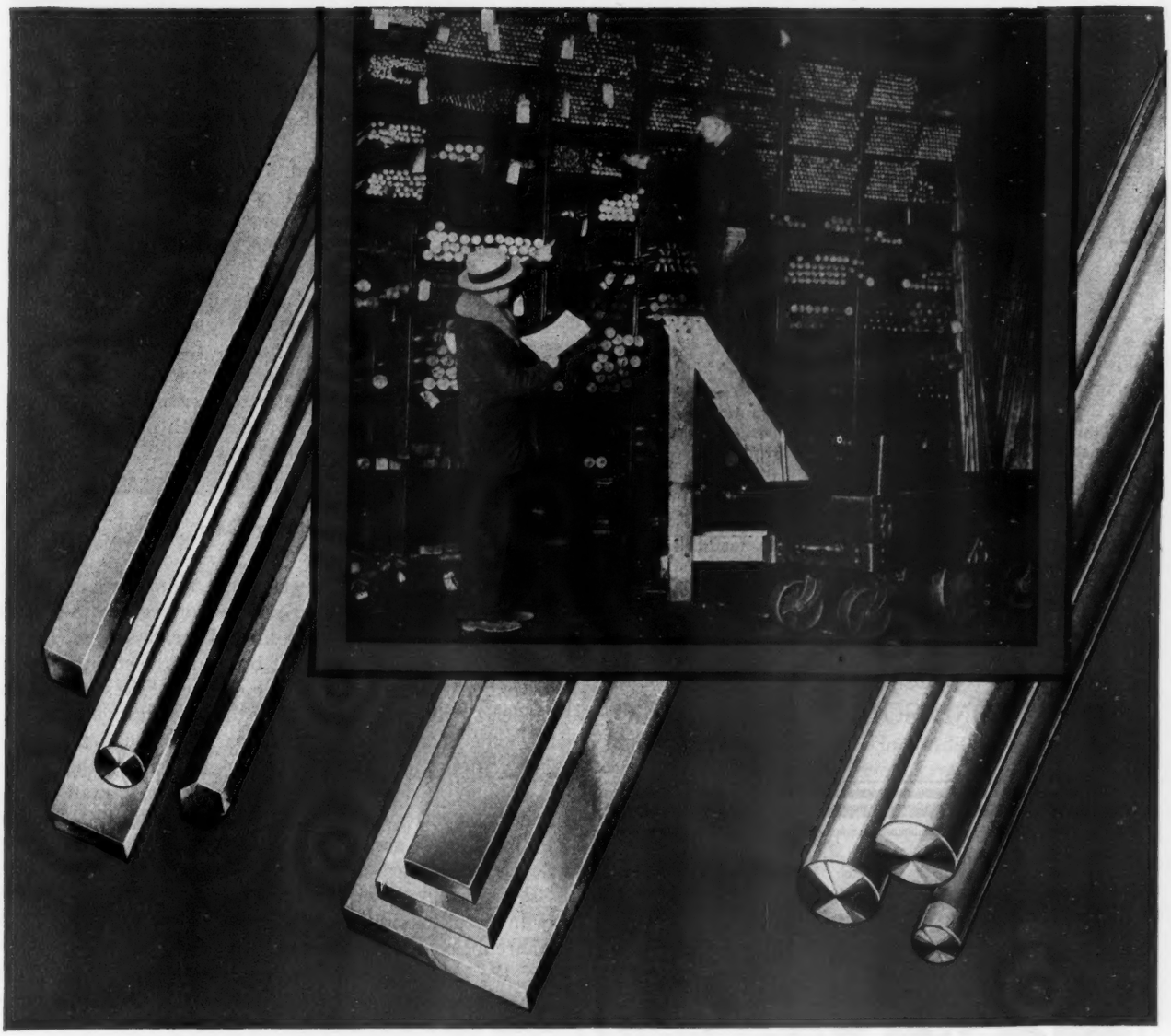
(Continued from editorial page 309)

•

groups outlined above. The automotive-type engines require little more in the way of a foundation than do electric motors of the same output. Higher-speed engines of the power class require a more substantial foundation and the slow-speed, heavy engines, large and expensive ones. All types of oil engines require exhaust piping to the outside of the building.

In general, factory power plants are of permanent character; consequently, weight and dimensions of the engines are of importance only in so far as they influence the cost of the space, transportation, and foundations. There are occasions, however, when additional power, either temporary or permanent, is necessary at some point not easily supplied by the main power plant. The automotive type of diesel not only affords the means of meeting such a situation at small expense for installation, but is adapted to frequent changes in location.

There are few plants that do not require heat for processing, for warming the premises, or for sanitary



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services. A large part of the energy commonly wasted in the water jackets and exhaust gases of oil engines can be utilized for these purposes. When considering a diesel installation in an industrial plant, utilization of the available heat from these sources should be investigated.

Installed cost of an oil engine varies according to many local conditions and is influenced by the type, specifications, rating, auxiliary equipment, and so on. As a general guide, it may be assumed that, excluding land and buildings but including normal foundations, piping, tanks, auxiliaries, transportation, erection, and starting, diesel engines ranging from about 50 to 1,000 hp. cost from about $100 to less than $60 per horsepower. For oil-electric units it is necessary to add 15 to 25 per cent for the generator, switchboard, wiring, and erection. A waste heat boiler with piping, installed, will add 8 to 10 per cent to the cost.

Operating Data

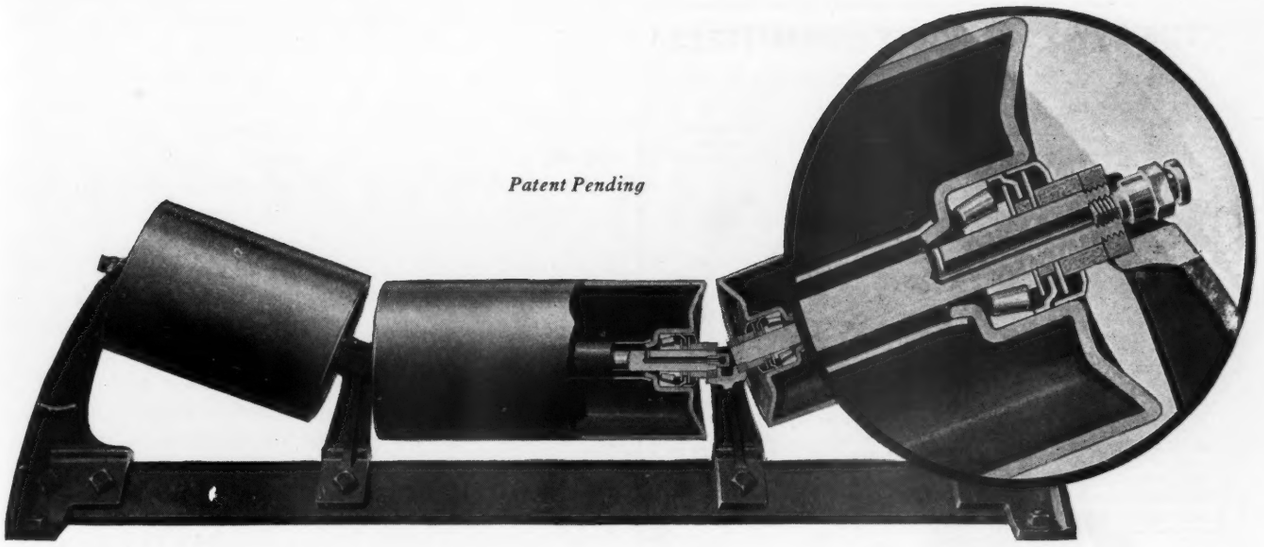
The table gives data obtained from the operation of a diesel installation that was recently made in a large cotton duck mill, replacing an old steam plant. In the old boiler room a waste heat boiler has been installed in the exhaust line of each of the engines. These are plain, vertical, cylindrical, fire tube boilers arranged so that the exhaust gases make three passes through the tubes. The temperature of the exhaust gas leaving the engine is about 700 degrees Fahrenheit. Steam output of the boilers at 80 pounds gage, superheated 100 degrees Fahrenheit, is about 1 pound per hour per horsepower developed by each engine.

Feed water for the boilers is taken from the engine cylinder jackets, where it is heated to about 120 degrees Fahrenheit. Since this supply exceeds the requirements for the exhaust-heated boilers, feed water for the old fuel-fired boilers is also supplied from this source. Steam required by the mill for process work is in excess of that produced by the exhaust-heated boilers; so the deficiency is made up by operating some of the old boilers.

Although diesel engines are used in industrial plants primarily as main power generating units, there are many cases where substantial economies can be effected by using them as an auxiliary to a steam plant, or to supplement purchased power. In the case of the steam plant labor charges sometimes may be reduced by shutting it down over week-ends, holidays, and slack seasons. All of the load may be carried by one or more oil engines fitted with safety devices so that the watchman or others on duty can attend to other work for several hours at a time.

Again, the steam plant can be operated at its most economical output by using a diesel auxiliary to take care of peak loads as well as all of the load during those periods when the steam plant can not be operated at high efficiency.

A good example of how an existing steam plant may be supplemented by a diesel engine in order to replace auxiliary central station service is found in a New England plant. A corliss engine direct-connected to a 150-kw., 150-r.p.m., direct-current generator supplied part of the power requirements; the remainder was



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purchased as alternating current and converted to direct current by a 150-kw. motor-generator set. Steam required for processing was less than the amount furnished by the corliss engine when operating at full capacity. The boiler capacity was not sufficient to operate another engine and the low boiler pressure used and the relatively small size of the additional unit required made an extension of the steam plant impracticable.

A thorough study of the situation was made, taking into consideration the facts that an existing coal storage building could be used as an engine room, and that the personnel for the steam plant could also operate a diesel auxiliary. It was decided to use the corliss engine as a reducing valve for the process steam and install a 150-kw., oil-electric generating unit to replace purchased power and to produce some of the current previously generated by the steam plant, so that operation of the latter could be restricted to the requirements for process steam.

A 225-b.hp., 360-r.p.m., four-cylinder, four-stroke-cycle, solid-injection diesel engine was installed last February.

In this plant it is possible to predict the steam requirements at the start of each day's production. The boiler and steam engine are then operated so as to meet that demand. The diesel unit floats on the line, carrying the portion of the load that is above the base output of the steam engine.

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According to estimates, the diesel unit will produce about 227,000 kw.-hr. a year, replacing 50,000 kw.-hr. of generated and 177,000 kw.-hr. of purchased energy. The complete installation cost about $20,000. Considering fuel, lubricating oil, maintenance, and interest on the investment, it is estimated that the annual saving will be more than $5,000 a year, which will retire the initial investment within four years. In this estimate no allowance has been made for depreciation or obsolesence, and no charge has been made for labor, since there has been no increase in the power plant force.

Many local conditions, such as maximum demand, restriction of hours during which maximum use can be made of purchased current, and others, sometimes interfere with the most economical production schedule. At other times the combination of demand and energy charges results in an abnormally high cost of power by reason of some local condition either in the plant or in the rate schedules. Study of these conditions may disclose how substantial economies can be effected by combining utility service with diesel engine power so as to purchase power at the lowest rates, while operating the oil engines at such times and under such loads as will produce the greatest return for the fuel, labor, and capital charges.

Reliable and economical power can be secured from steam plants, utility service, and diesel engines. Local conditions govern the relative costs to a large extent, and no general statement can honestly be made as to which of the three sources is cheaper and better for the average plant. That is a question which can be answered correctly only after a thorough investigation. Some of the more important factors that must be considered are given in the tabulation (page 309).

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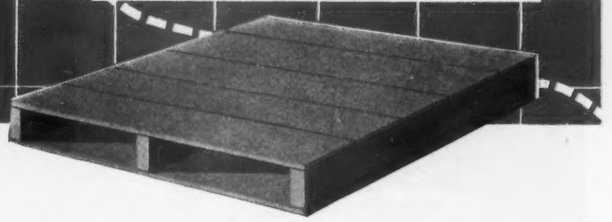

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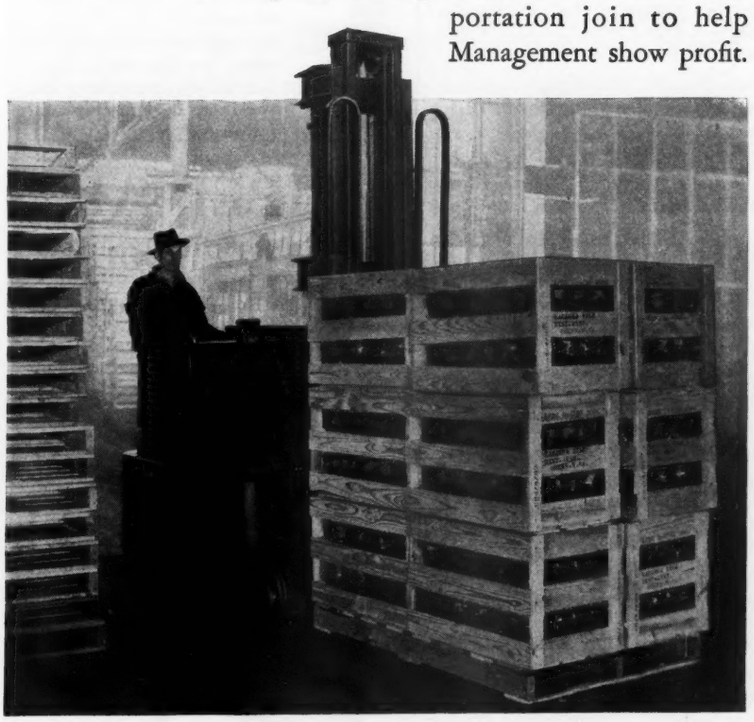

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TRADE LITERATURE

(Continued from editorial page 338)

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LUBRICATION DEVICES—Catalog, "Triple S Products."—Specialty Sales and Service Corp., 138 Holden St., Minneapolis.

METERS—Booklet, "Solving Industrial Crimes, Case No. 2." Describes various indicating and recording instruments.—The Esterline-Angus Co., Indianapolis.

METERS—Bulletin 1375, describes "Megger" capacity meter; Bulletin 1380, describes Midget "Megger" circuit-testing ohmmeters. — James G. Biddle Co., 1211 Arch St., Philadelphia.

MONORAIL, CRANES—Form G 234, "Has a Cleveland Tramrail Man Shown You?"—The Cleveland Crane & Engineering Co., Wickliffe, Ohio.

MOTOR REDUCERS—Bulletin No. 271, line of vertical Motoreducers. — The Falk Corp., Milwaukee, Wis.

MOTORS—Leaflet No. 2173, squirrel cage induction, Type "AR." — Allis-Chalmers Mfg. Co., Milwaukee.

MOTORS—Bulletin, "Heat Conquered by Public Enemy No. 1 of Motors." Describes "Linc-Weld" self-protecting motors.—The Lincoln Electric Co., Cleveland.

MOTORS—Bulletin 167, Part 8, looseleaf sheets on the subject of direct-current motors.—Wagner Electric Corp., 6400 Plymouth Ave., St. Louis.

OUT-VOLTAGE REGULATOR—Catalog No. 10, Katherton regulator for eliminating light flicker.—Roller-Smith Co., 233 Broadway, New York.

PACKING—Booklet, describing Tripplastic semi-metallic packing.—Wm. B. Merrill & Co., Boston, Mass.

PAINT—Bulletin, "Buy It By the Foot," describes Permite Aluminum Paint.—Aluminum Industries, Inc., Cincinnati.

PROJECTION APPARATUS — Catalog No. 577, describes desk-type projection apparatus for inspection, measurement, photography of small manufactured objects.—The R. Y. Ferner Co., 930 Investment Bldg., Washington, D. C.

PUMPS — Bulletin D-475-B9, describing internal-bearing, double-helical rotary pumps.—Worthington Pump and Machinery Corp., Harrison, N. J.

PUMPS, COMPRESSORS—Bulletins No. 223 and 104, LS centrifugal pumps and air compressors. — Pennsylvania Pump and Compressor Co., Easton, Pa.

SAFETY EQUIPMENT—Several leaflets and folders on goggles, gloves, waste cans, skin cream, aprons, etc.—Safety Equipment Service Co., 1228 St. Clair Ave., Cleveland.

SEALING COMPOUND — Folder, "New! Ideal Perfect Seal—One Thousand Industrial Uses."—Ideal Commutator Dresser Co., Industrial Div., Sycamore, Ill.

SHEET METAL—Bulletin 120, "Republic Galvannealed Sheets." — Republic Steel Corp., Youngstown, Ohio.

SPEED REDUCERS—Bulletin No. 130, "The Answer To a Century-Old Problem, Sterling System of Infinite Speed Variation."—Sterling Electric Motors, Inc., Telegraph Road at Atlantic Blvd., Los Angeles.

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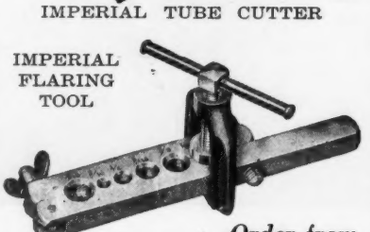

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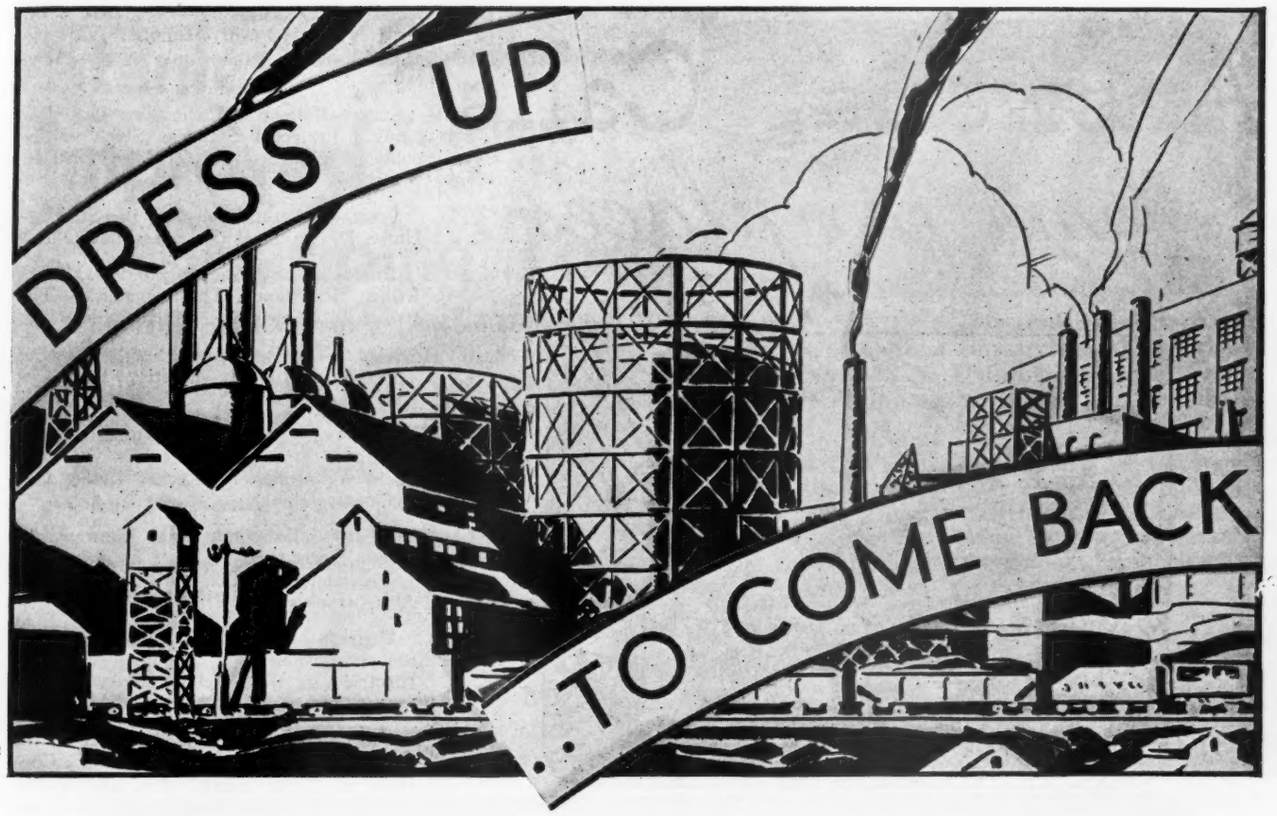


Run down plants everywhere are sprucing up by painting up. Well-kept plants are well-painted plants and Dixon's Industrial Silica-Graphite Paint is still the favorite after 75 years of use all over the world.

Depend on this reliable old Dixon product.

FOR

Structural Steel . . Water Conduits Grain Elevators . . Roofs . . Bridges Boilers . . Gas Tanks . . Oil Tanks Water Tanks . . Tank Cars . . Coal Tipples . . Iron Fences . . Lamp Posts Holders . . Smokestacks . . Marine Work . . Steel and Wood Barges Condensers . . Transformers . . Excavating and Hauling Machinery

USE

It provides greatest obtainable protection indoors and out—costs least per year per square foot.

Nothing equals natural flake graphite for water repellency. Combined with silica in pure boiled linseed oil, as in Dixon's Silica-Graphite Paint, you have a coating that keeps appearances up, keeps maintenance down. Available in any of 14 colors including Bright Aluminum. Color card and Master Specification No. 44BA are yours for a word.

Paint Sales Division

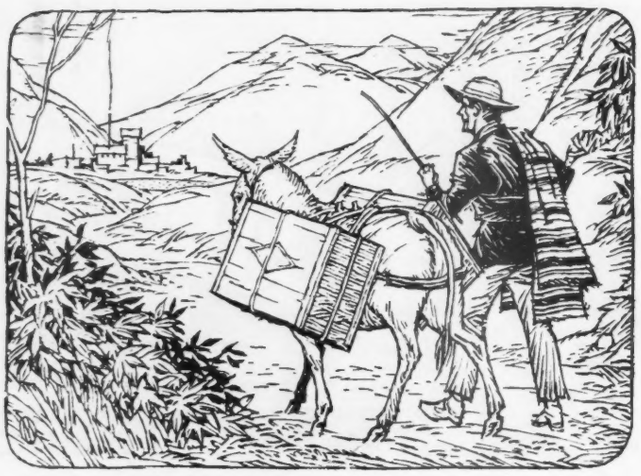
JOSEPH DIXON CRUCIBLE CO.

Established 1827 D X N TRADE MARK Jersey City, N. J.

DIXON'S INDUSTRIAL SILICA-GRAPHITE PAINT

540

Answering Calls *from far places*



FROM every quarter of the earth—from mines in the Andes and factories in Australia —from refineries in Roumania and canneries in Japan—from shipyards in Britain and steam plants in Africa, come a ceaseless flow of orders for Jenkins Valves.

This universal faith in Jenkins Valves is a tribute that engineers everywhere pay to correct design, superior quality and dependable performance. It is a faith that we value highly, and it places a responsibility upon us which we gladly accept. In the future, as in the past, Jenkins Valves will represent those advanced but sound engineering principles and manufacturing practices, so essential to economical and satisfactory valve service.

Whether you require bronze, iron, or steel valves, the purchase of Jenkins Valves is always an economy, never an extravagance.

Men who "know" valves will recognize the excellence of Jenkins Iron Body Gate Valve design and construction. There are 24 important features, clearly shown in the life-like cut-out model of a "Jenkins" which your supply house will give you. Use it to compare with other valves. See the Jenkins Catalog for details on Iron Body Gates with Solid Wedge or Double Disc Parallel Seat in sizes to 48 inches.

Jenkins Bros

JENKINS BROS., 80 White Street, New York, N. Y. 510 Main Street, Bridgeport, Conn.; 524 Atlantic Avenue, Boston, Mass.; 133 N. Seventh Street, Philadelphia, Pa.; 822 Washington Boulevard, Chicago, Illinois; JENKINS BROS., Limited, Montreal, Canada; London, England

JENKINS VALVES · SINCE 1864 · BRONZE · IRON · STEEL

SPEED TRANSMISSION—Book No. 1274, "P. I. V. Gear, Positive Infinitely Variable Speed Transmission."—Link-Belt Co., Chicago.

STEEL—Bulletin 125, "Enduro 18-8, Republic's Perfected Stainless Steel." — Republic Steel Corp., Central Alloy District, Massillon, Ohio.

STEEL—Bulletin, "Selecting the Steel."—Union Drawn Steel Co., Massillon, Ohio.

THERMOMETER—Catalog No. 9001, "New Brown Resistance Thermometer." — The Brown Instrument Co., Philadelphia.

TOOLS—Catalog No. 64, Stanley Electric Tools.—The Stanley Electric Tool Co., New Britain, Conn.

TRANSMISSION — Folder, describes and illustrates features of Reeves Variable Speed Transmission.—Reeves Pulley Co., Columbus, Ohio.

TRAPS — Bulletin, "Tag Thermostatic Steam Traps, Sizes: ½ in., ¾ in., 1 in."—C. J. Tagliabue Mfg. Co., Park and Nostrand Ave., Brooklyn, N. Y.

UNILETS—Bulletin No. 1003, on Appleton Explosion-Proof Unilets. — Appleton Electric Co., 1701 Wellington Ave., Lakeview Station, Chicago.

VENTILATION—Folder, "What About the Ventilation in Your Buildings? . . the Controls on Your Steam, Air, and Water Lines?" Describes ventilators, traps, etc. —The Swartwout Co., 18511 Euclid Ave., Cleveland.

WATER SYSTEMS—Catalog No. 30, 160 pages, describes Deming pumps, water systems, and auxiliary parts and equipment.—The Deming Co., Salem, Ohio.

WELDERS—Leaflet, 4 pages, describes Flexarc Cletrac Welders.—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

WELDING—Application Sheet No. 37—Series 2, "Elements of Design—Application of Tubular Shapes."—The Lincoln Electric Co., Dept. 237, Cleveland.

WELDING LENS—Leaflet, "The Importance of Proper Selecting of a Protective Welding Lens."—The Lincoln Electric Co., Cleveland.

WIRE, CABLE—Bulletin, "U R C Weatherproof Wires and Cables."—General Cable Corp., 420 Lexington Ave., New York.

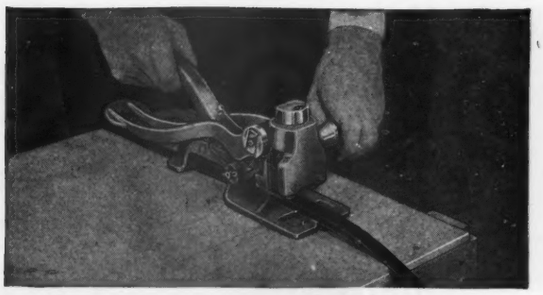
BOOKS

THE THEORY OF WAGES

Paul H. Douglas, Professor of Economics, University of Chicago. The Macmillan Co., 60 Fifth Avenue, New York. 639 pages, statistical appendix, bibliography, charts, tables, figures, index. $5.

Hart, Schaffner and Marx 1926 prize winner, since continuously revised and just published. Analyzes the way wages are fixed under equilibrium conditions and develops the theory of production. From an inductive study of changes in quantity of labor, capital, and production, it measures the contribution to

Stanley Improved "3 in 1" Strapping Tool



This latest model Stanley Tool combines in one unit the tightening, sealing and cutting operations, thus doing away with the now obsolete three-tool method.

Banding packages for safe transit and delivery has long since proven its tangible worth. We now offer a greatly improved tool that does the job *faster* and *better*, and at a *material saving* in cost.

This New "3 in 1" Tool is sturdily built, easy to operate and a great improvement over the original Stanley "3 in 1", which was the first combination strapping tool ever put on the market.

Your own INDIVIDUAL BRAND of Nailless Strapping, bearing your Company Name, Trademark or Slogan in BRILLIANT COLORS, coupled with this time saving equipment, make possible the very highest efficiency in package reinforcement.

THE STANLEY WORKS

New York	Box Strapping Division	Chicago
100 Lafayette St.	New Britain, Conn.	62 W. Kinzie St.

STANLEY EVERSAFE (Round Safety Edges) Japanned Nailless Strapping furnished in all standard widths and gauges.

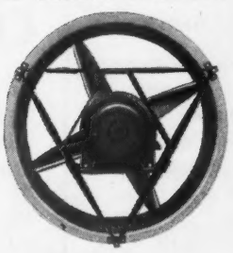
FLORIDA CITRUS EXCHANGE

Illustration of Colorgraph Strapping, which can be finished in any design and almost any color combination.

give 'em AIR!

Your industrial ventilating fans will do the job they're intended to do, if Bendix P-Y-P is specified. *More air per horsepower* is assured, because of the unique Bendix propeller blade design and Bendix Venturi Ring. The air flow is smooth —no eddies.

A BENDIX PRODUCT



All types — wall, ceiling, floor and portable—in all sizes from 16″ two-blade to 36″ four-blade. Finest forged aluminum alloy blades, rolled steel frames and motor supports. Bendix Engineering counsel always cheerfully at your service for your special ventilation problems. Write

P — Y — P (BENDIX FANS)

BENDIX PRODUCTS CORPORATION
(Industrial Fan Division)
409 Bendix Drive, South Bend, Ind.

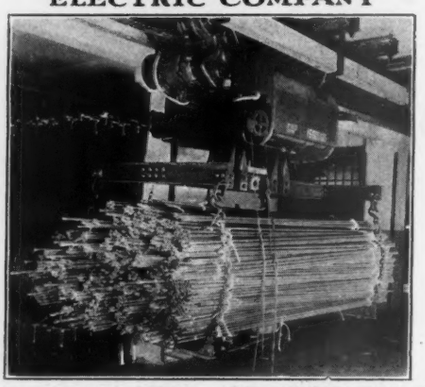
BENDIX FANS

TO BE SURE that their new Electric Clipper would be lighter, stronger, more attractive in appearance, and so have greater sale appeal, John Oster Mfg. Co. specified "all parts to be molded of Bakelite by the Chicago Molded Products Corp."

If your product needs redesign to make it more salable and to lower manufacturing costs—use these same specifications. Our Engineering and Design Departments will cooperate with you upon request.

CHICAGO MOLDED PRODUCTS CORP.
2148 Walnut St. **Chicago, Ill.**

Now GraybaR
ELECTRIC COMPANY



UNLOADS 40,000 LBS. OF PIPE IN 20 MINS.

ONLY a Lo-Hed hoist could give the maximum lift on this job where the ceiling is only 12 ft. above the floor; and typical of Lo-Hed performance this 8 ton hoist has been handling loads of 5 tons continuously all day long since 1930, and there has been no maintenance cost since it was placed in service. It unloads a carload of pipe in 20 minutes!

Lo-Hed hoists are saving space, time, money, and labor on all kinds of difficult jobs. They are superior in design, rugged, durable, all-steel, and made in ½ ton to 12 tons capacity. Investigate their proven money saving capabilities. Write for bulletins giving useful information.

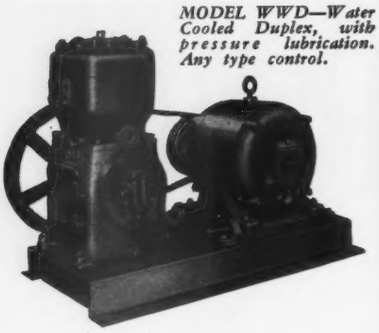
AMERICAN ENGINEERING CO.
2466 ARAMINGO AVENUE, PHILADELPHIA

LO-HED PATENTED

QUINCY
COMPRESSORS
LOW COST AIR

Quincy Compressors and dependable low cost air mean the same thing—no matter how you look at it . . . The more you investigate the more you will be convinced that Quincy not only fits right into low cost, regular, intermittent or stand-by service—but they deliver a plus value which results from built in mechanical excellence, sound design, and modern improvements . . . Investigate Quincy Compressor Features.

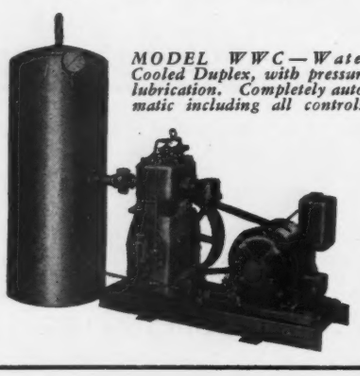
MODEL WWD—Water Cooled Duplex, with pressure lubrication. Any type control.



AIR ENGINEERING SERVICE

Special engineering advice on the application of the right compressor to the right job makes Quincy a name well worth remembering when you think of air . . . Ask about Quincy Air Engineering Service.

MODEL WWC—Water Cooled Duplex, with pressure lubrication. Completely automatic including all controls.



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302 MAINE STREET, QUINCY, ILLINOIS
205 W. Wacker Drive, Chicago, Illinois
30 Church Street, New York, New York

QUINCY Compressors

production by labor and capital. It measures the degree to which distribution follows production.

The effect of changes in wage rates on number of hours worked and proportion of workers employed, the interrelation of real wages and population growth, the supply curves of labor, capital, and natural resources are dealt with. From an inductive study of productivity and supply functions, the author works out an inductive theory of distribution.

DEPRESSION AND RECOVERY

Dale Yoder, Associate Professor of Social Economics, and George R. Davies, Professor of Business Statistics, College of Commerce, State University of Iowa. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York. 298 pages, appendix, bibliography, index. $2.

Summarizes important aspects of economic disorganization, describes devices of recovery campaign for furthering reconstruction. Presents (1) nature and history of depressions in brief; (2) analysis of phases of latest depression; (3) summary of recovery devices and their economic implications.

BILANZ-THEORIEN

Dr. Wilhelm Chr. Hauck, Professor of Factory Management, Heidelberg University. Verlag Konkordia A. G. Buehl-Baden, Germany. 131 pages, index, figures, tables.

Published in German. Concerned with the mathematical foundations for budgeting.

THE SCIENCE OF WORK

Morris T. Vitches, W. W. Norton & Co., Inc., New York. 414 pages. References, index. Drawings, figures, tables. $3.75.

Non-technical discussion of how psychology is applied in making work a happier and more productive activity. Shorter and simpler than the author's earlier survey of the same subject; free from technical and statistical terminology.

On the Calendar

JULY

7-21, The Summer Institute for Social Progress, Wellesley College, Wellesley, Mass. M. B. Luitweiler, Chairman of Admissions Committee, Millburn, N. J.

OCTOBER

1-4, Illuminating Engineering Society, 28th annual convention, Baltimore, Md., D. W. Atwater, General Secretary, 29 West 39th St., New York.

1-5, American Society for Metals, annual convention, New York. W. H. Eisenman, Secretary, 7016 Euclid Ave., Cleveland.

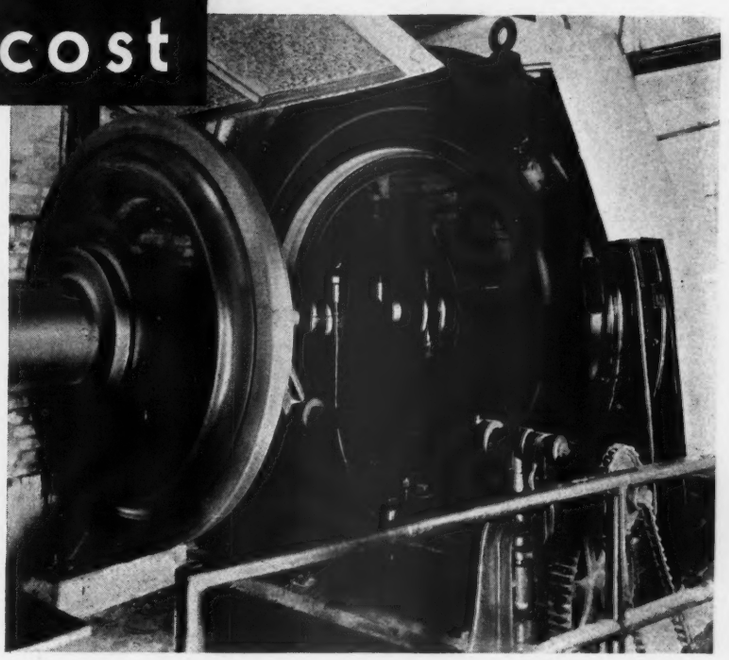
1-5, National Metal Congress and Exposition, Commerce Hall, Port of New York Authority Bldg., New York. W. H. Eisenman, Secretary, 7016 Euclid Ave., Cleveland.

15-18, American Institute of Accountants, annual meeting, Chicago. John L. Carey, Secretary, 135 Cedar St., New York.

Modernize . . . but do it wisely for best results and lowest cost

★ *You can get all three at small cost*

①Production Efficiency
②Power Economy
③Low Maintenance

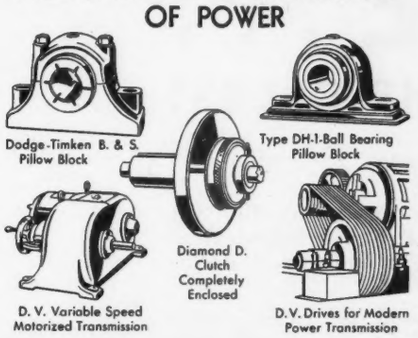


A MIDDLE-WESTERN grain elevator was faced with the problem of constantly increasing power costs. A careful survey was made with due consideration being given to the possibility of utilizing existing equipment. A centralized mechanical drive operated by a synchronous motor was finally selected. The good features of the existing drive were retained and the best in modern power layout was added.

The immediate results in this case were low capital outlay and least interruption of operations to make the change. The permanent result is much lower power costs and more dependable performance.

It doesn't cost much to replace those parts not profitable. Modern Dodge Drives selected on the basis of production needs and applied to your machines is a dependable way to obtain lower cost operation.

★ EVERYTHING FOR THE MECHANICAL TRANSMISSION OF POWER


Dodge-Timken B. & S. Pillow Block
Type DH-1-Ball Bearing Pillow Block
Diamond D. Clutch Completely Enclosed
D. V. Variable Speed Motorized Transmission
D.V. Drives for Modern Power Transmission

Repair Costs Are 60 Per Cent Less

In an eastern gypsum plant a lineshaft delivered power to three cookers. Belt maintenance was too costly. Dodge engineers selected the right drive for the job and maintenance costs dropped 60%.

Savings . . . Savings . . . Savings

A tobacco manufacturer installed Dodge-Timken Bearings and eliminated oil drip that was causing heavy spoilage losses—a manufacturer of printing rollers saved $3,000.00 on first cost alone and solved a troublesome production problem—a paper company increased production 30% and cut power consumption 50%.

Specialized Engineering Service

Dodge offers specialized engineering, plus a complete line of transmission appliances, which insures unprejudiced recommendations. With Dodge engineers, production needs always dictate choice of drive.

NOW *is the time to Modernize for Profit.* SEND FOR BOOKLET

You can eliminate lazy machines, increase production and cut costs substantially by replacing old drives with new, installing new bearing equipment, new clutches, etc. This can be accomplished at low cost. Send for our picture book "Profitable Industrial Modernization." It shows and tells how others have obtained production efficiency, power economy and low maintenance at small cost.

DODGE
MISHAWAKA
THE *Right* DRIVE FOR EVERY JOB

DODGE MANUFACTURING CORPORATION · MISHAWAKA, INDIANA

● **Inside Frosted Lamp**—*Hygrade also makes large-style lamps in many hundred types and sizes.*

YOU PAY **TWICE . . .**

FOR POOR LAMP BULBS!

● **First cost is the least important cost when you buy lamp bulbs.**

For, an incandescent lamp is simply a machine for transforming electricity into light. If the machine is good, you get maximum light from every dollar on your light bill.

If the machine is poor . . you pay twice — once for the poor bulb itself and once again for the current it wastes when you burn it!

Experts know that Hygrade Lamp Bulbs are as perfect as skilled American workers can make them. They pass the exacting requirements of the United States Government.

NRA WE DO OUR PART

HYGRADE SYLVANIA CORPORATION, Salem, Mass.
Makers of fine Incandescent Lamps for more than 30 years

HYGRADE
LAMP BULBS

A PRODUCT OF HYGRADE SYLVANIA CORPORATION
Manufacturers of Hygrade Lamps, Sylvania Radio Tubes, Electronic Products

You Want to Know

(Continued from editorial page 311)

●

• AN EGG CARTON, designed to hold a dozen eggs, may be torn in half for half-dozen buyers. Perforated for easy separation, one big one is cheaper to make than two small ones.

• ELECTRICAL CORD, rubber insulated and sheathed with a rubber-like material, is supposed to be impervious to oil and gasoline.

• WALL PANEL, new, of plywood with a bonded metal face. For interior, exterior construction. In stock sizes up to 36 by 96 inches.

• WHY, objects a manufacturer, do you mention the fact (in the June issue) that the British can draw wire to 0.002 inch thick? American manufacturers can draw and enamel wire, he says, as fine as 0.0007 inch. His own concern manufactures 0.001-in. wire in regular production.

• DISPLAY STAND helps salesmen sell 36 packages of aspirin at one crack, brings automatic repeats on subsequent calls, jumps aspirin sales 30 per cent. It's molded.

• "HANG-IT-ALL" is, so far as we're concerned, the best trade name of the month. It's a copper rack which a manufacturer has designed for the neat and handy display in the kitchen of copper (he hopes) or aluminum (hang it all!) pots and pans.

• IF you've anything to mark, a concern we know makes aluminum markers. For instance, the telephone people use them to mark poles with height, age, etc.

• CRATES ON CASTERS are used by a cooking utensil manufacturer for conveying small packages to the post office. The cooking utensils are aluminum. So are the crates.

• ADJUSTMENT of the twisting force in a new manually operated screw-capping machine insures a satisfactory seal, yet permits the gentler sex to open the package without calling for help.

• ONE of the latest and slickest of those re-use containers is an olive oil flask that becomes a good-looking flower vase when the oil's all gone.

• PIES baked by a New York baker are protected by a transparent cellulose covering which is held in place by a ring stapled to the paper plate. Three stapling machines package 35,000 pies in an 8-hr. day.

• WINDOW-TOP CANS are used by a Chicago packer to help retailers boost sales. One is included in each four- or five-case shipment.